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THE WILLAMETTE BASIN COMPREHENSIVE STUDY OF WATER AND RELATED L--ETC(U)
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# WILLAMETTE BASIN

## COMPREHENSIVE STUDY

### Water and Related Land Resources

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## APPENDIX D

# FISH AND WILDLIFE



WILLAMETTE BASIN TASK FORCE - PACIFIC NORTHWEST RIVER BASINS COMMISSION

1969

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# The WILLAMETTE BASIN

## COMPREHENSIVE STUDY of

## Water and Related Land Resources



## APPENDIX D

# FISH AND WILDLIFE

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WILLAMETTE BASIN TASK FORCE - PACIFIC NORTHWEST RIVER BASINS COMMISSION



(11) 1969

(12) 350p.

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# CREDITS

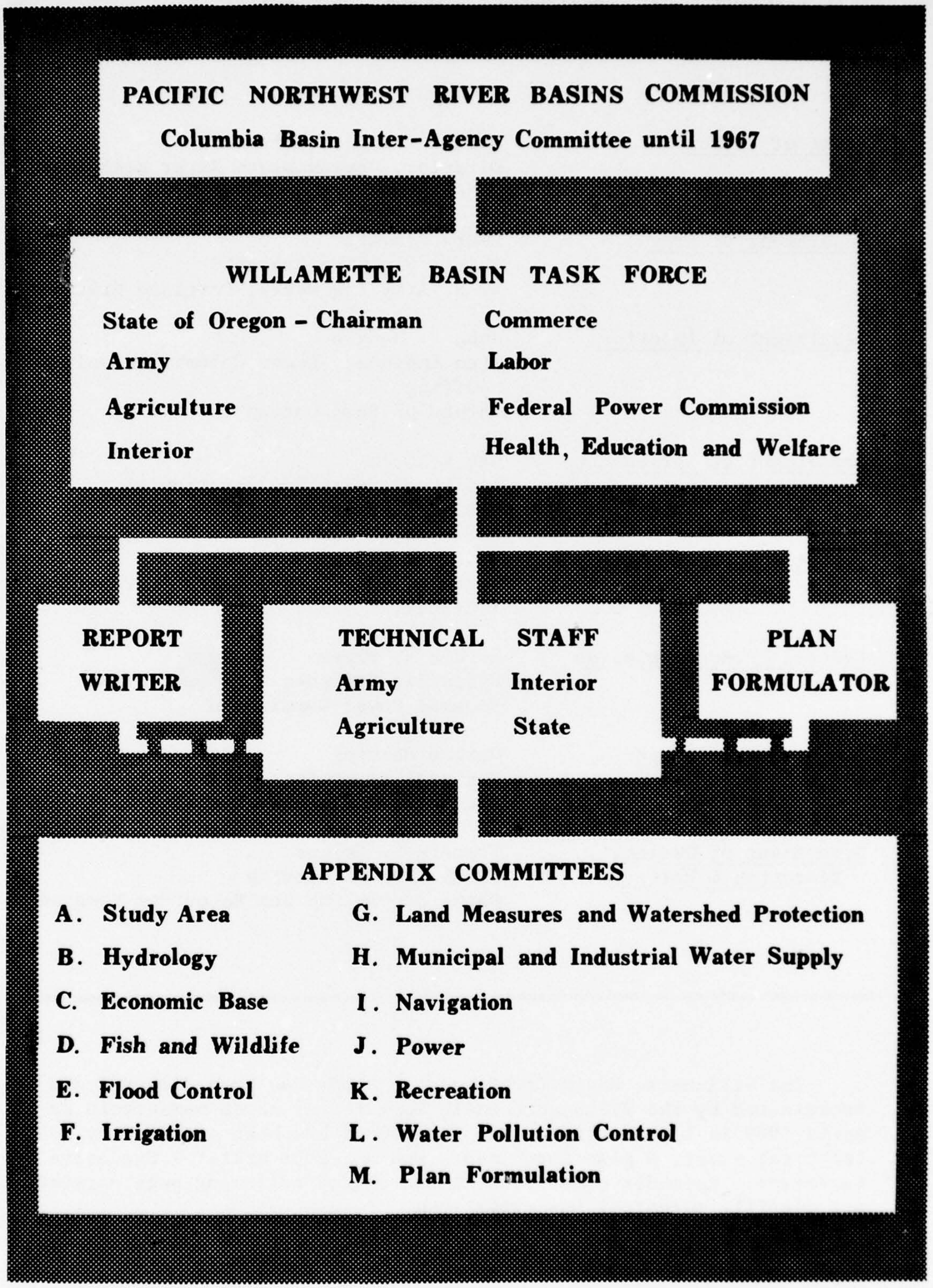
This is one of a series of appendices to the Willamette Basin Comprehensive Study main report. Each appendix deals with a particular aspect of the study. The main report is a summary of information contained in the appendices plus the findings, conclusion, and recommendations of the investigation.

This appendix was prepared by the fish and wildlife agency representatives with review by other committee members. The Committee was chaired by the Bureau of Sport Fisheries and Wildlife and included representation from the following agencies:

Bureau of Commercial Fisheries
Bureau of Land Management
Bureau of Outdoor Recreation
Corps of Engineers
Federal Water Pollution Control Administration
Forest Service
Geological Survey
Soil Conservation Service
Fish Commission of Oregon
Oregon State Game Commission
State Water Resources Board

Pictorial sketches were prepared by Harold Cramer Smith of Oregon State Game Commission.

# ORGANIZATION



# WILLAMETTE BASIN TASK FORCE

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|---|---|
| State of Oregon | Donel J. Lane, Chairman<br>Director, Oregon State Water Resources Board |
| Department of Army | Henry Stewart<br>Chief, Planning Branch<br>U. S. Army Engineers, Portland District |
| Department of Interior | John F. Mangan<br>Area Engineer, Lower Columbia Development Office<br>Bureau of Reclamation |
| Department of Agriculture | Oke Eckholm<br>Assistant State Conservationist<br>Soil Conservation Service |
| Department of Commerce | David J. Bauman<br>Hydrologist, Weather Bureau Forecast Center |
| Federal Power Commission | Gordon N. Boyer<br>Hydraulic Engineer<br>Federal Power Commission |
| Department of Labor | Horace Harding<br>Regional Economist<br>Bureau of Employment Security |
| Department of Health, Education & Welfare | Francis L. Nelson<br>Public Health Service<br>Water Supply and Sea Resources Program |

The Willamette Basin Comprehensive Study has been directed and coordinated by the Willamette Basin Task Force, whose membership as of April 1969 is listed above. The Task Force has been assisted by a technical staff, a plan formulator, and a report writer - Executive Secretary. Appendix committees listed on the following page carried out specific technical investigations.

# APPENDIX COMMITTEES

| Appendix-Subject | | |
|---|---|---|
| A - Study Area | OSWRB - Chairman: | FWPCA, USBPA, USBLM, USBM, USBOR, USBR, USBSFW, USCE, USERS USFS, USGS, USNPS, USSCS, OSDC, OSDF, OSDG&MI, OSS&WCC, OSU |
| B - Hydrology | USGS - Chairman: | FWPCA, USBPA, USBR, USCE, USSCS, USWB, OSE, OSWRB |
| C - Economic Base | USCE - Chairman: | FWPCA, USBPA, USBCF, USBM, USBOR, USER, USBSFW, USDL, USERS, USFS, OSDC, OSU, UO, PSC-PR&C |
| D - Fish and Wildlife | USBSFW - Chairman: | FWPCA, USBCF, USBLM, USBOR, USCE, USFS, USGS, USSCS, FCO, OSGC, OSWRB |
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| F - Irrigation | USBR - Chairman: | USSCS, OSDC, OSWRB, OSU |
| G - Land Measures and Watershed Protection | USSCS - Chairman: | FWPCA, USBCF, USBLM, USBOR, USBR, USBSFW, USFS, OSU |
| H - M&I Water Supply | FWPCA - Chairman: | USBR, USBSFW, USGS, USSCS, OSBH, OSDC, OSWRB, USHEW |
| I - Navigation | USCE - Chairman: | OSDC, OSMB, POP, OSU |
| J - Power | USBPA - Chairman: | FPC, FWPCA, USBCF, USBR, USCE, USFS, USGS, OSE, OSWRB |
| K - Recreation | USBOR - Chairman: | FPC, FWPCA, USBLM, USBSFW, USCE, USFS, USNPS, USSCS, OSBH, OSDC, FCO, OSGC, OSHD-PD, OSMB, OSWRB, LCPD, OCPA, USHEW |
| L - Water Pollution Control | FWPCA - Chairman: | USBCF, USBLM, USBOR, USBR, USBSFW, USGS, USSCS, OSBH, OSE, FCO, OSGC, OSWRB, OSU, USHEW |
| M - Plan Formulation | Plan Formulator - Chairman: | USCE, USDA, USDI, OSWRB |

FPC - Federal Power Commission
FWPCA - Federal Water Pollution Control Administration
USBPA - Bonneville Power Administration
USBCF - Bureau of Commercial Fisheries
USBLM - Bureau of Land Management
USBM - Bureau of Mines
USBOR - Bureau of Outdoor Recreation
USBR - Bureau of Reclamation
USBSFW - Bureau of Sport Fisheries and Wildlife
USCE - Corps of Engineers
USDA - Department of Agriculture
USFWS - Fish and Wildlife Service (BSFW and BCF)
USHEW - Department of Health, Education and Welfare
USDI - Department of Interior
USDL - Department of Labor
USERS - Economic Research Service
USFS - Forest Service
USGS - Geological Survey
USNPS - National Park Service
USSCS - Soil Conservation Service

OSBH - Oregon State Board of Health
OSDC - Oregon State Department of Commerce
OSDF - Oregon State Department of Forestry
OSDG&MI - Oregon State Department of Geology and Mineral Industries
OSE - Oregon State Engineer
FCO - Fish Commission of Oregon
OSGC - Oregon State Game Commission
OSHD-PD - Oregon State Highway Department - Parks Division
OSMB - Oregon State Marine Board
OSS&WCC - Oregon State Soil and Water Conservation Committee
OSWRB - Oregon State Water Resources Board
OSU - Oregon State University
PSC-PR&C - Portland State College - Center for Population Research and Census Service
UO - University of Oregon
LCPD - Lane County Parks Department
OCPA - Oregon County Parks Association
POP - Port of Portland
USWB - Weather Bureau

# BASIN DESCRIPTION

Between the crests of the Cascade and Coast Ranges in northwestern Oregon lies an area of 12,045 square miles drained by Willamette and Sandy Rivers--the Willamette Basin. Both Willamette and Sandy Rivers are part of the Columbia River system, each lying south of lower Columbia River.

With a 1965 population of 1.34 million, the basin accounted for 68 percent of the population of the State of Oregon. The State's largest cities, Portland, Salem, and Eugene, are within the basin boundaries. Forty-one percent of Oregon's population is concentrated in the lower basin subarea, which includes the Portland metropolitan area.

The basin is roughly rectangular, with a north-south dimension of about 150 miles and an average width of 75 miles. It is bounded on the east by the Cascade Range, on the south by the Calapooya Mountains, and on the west by the Coast Range. Columbia River, from Bonneville Dam to St. Helens, forms a northern boundary. Elevations range from less than 10 feet (mean sea level) along the Columbia, to 450 feet on the valley floor at Eugene, and over 10,000 feet in the Cascade Range. The Coast Range attains elevations of slightly over 4,000 feet.

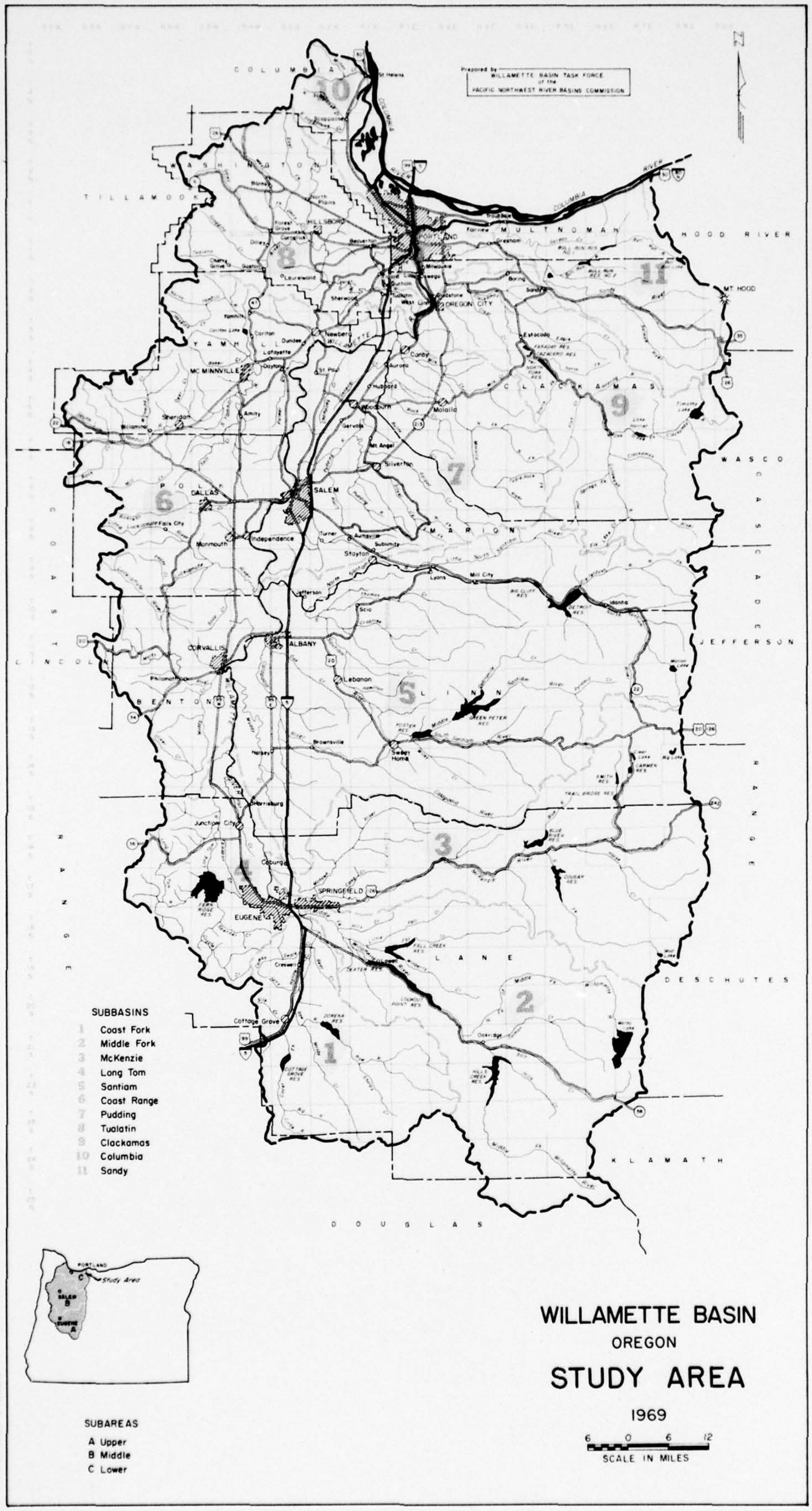
The Willamette Valley floor, about 30 miles wide, is approximately 3,500 square miles in extent and lies below an elevation of 500 feet. It is nearly level in many places, gently rolling in others, and broken by several groups of hills and scattered buttes.

Willamette River forms at the confluence of its Coast and Middle Forks near Springfield. It has a total length of approximately 187 miles, and in its upper 133 miles flows northward in a braided, meandering channel. Through most of the remaining 54 miles, it flows between higher and more well defined banks unhindered by falls or rapids, except for Willamette Falls at Oregon City. The stretch below the falls is subject to ocean tidal effects which are transmitted through Columbia River.

Most of the major tributaries of Willamette River rise in the Cascade Range at elevations of 6,000 feet or higher and enter the main stream from the east. Coast Fork Willamette River rises in the Calapooya Mountains, and numerous smaller tributaries rising in the Coast Range enter the main stream from the west.

In this study, the basin is divided into three major sections, referred to as the Upper, Middle, and Lower Subareas (see map opposite). The Upper Subarea is bounded on the south by the Calapooya Mountains and on the north by the divide between the McKenzie River drainage and the Calapooia and Santiam drainages east of the valley floor and by the Long Tom-Marys River divide west of it. The Middle Subarea includes all lands which drain into Willamette River between the mouth of Long Tom River and Fish Eddy, a point three miles below the mouth of Molalla River. The Lower Subarea includes all lands which drain either into Willamette River from Fish Eddy to its mouth or directly into Columbia River between Bonneville and St. Helens; Sandy River is the only major basin stream which does not drain directly into the Willamette.

For detailed study, the three subareas are further divided into 11 subbasins as shown on the map.


Prepared by
WILLAMETTE BASIN TASK FORCE
of the
PACIFIC NORTHWEST RIVER BASINS COMMISSION
COLUMBIA
TILLAMOOK
WASHINGTON
MULTNOMAH
HOOD RIVER
YAMHILL
CLACKAMAS
POLK
MARION
WASCO
LINCOLN
BENTON
LINN
JEFFERSON
LANE
DESCHUTES
KLAMATH
DOUGLAS
COAST RANGE
CASCADE RANGE
PORTLAND
SALEM
EUGENE
SPRINGFIELD
CORVALLIS
ALBANY
OREGON CITY
MC MINNVILLE
DALLAS
MT HOOD
SUBBASINS
1 Coast Fork
2 Middle Fork
3 McKenzie
4 Long Tom
5 Santiam
6 Coast Range
7 Pudding
8 Tualatin
9 Clackamas
10 Columbia
11 Sandy
SUBAREAS
A Upper
B Middle
C Lower
Study Area
WILLAMETTE BASIN
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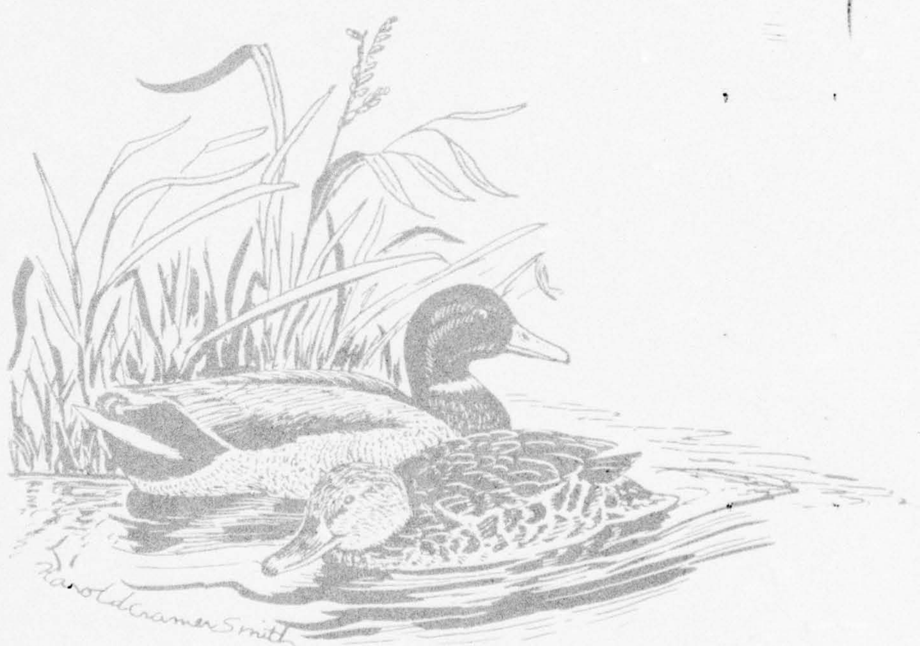
# INTRODUCTION

# INTRODUCTION

## PURPOSE AND SCOPE

The purpose of this appendix is to examine the fish and wildlife aspects of the Willamette Basin, and develop recommendations which will adequately provide for preservation and improvement of these resources. Included in this appendix are sections on: background information with a brief history of fish and wildlife; inventory of present fish and wildlife resources; appraisal of future supply and demand; alternative means to meet the demand; and a final section with a summary and recommendations based on data in the preceding sections.

This appendix is essentially single purpose in scope. The data presented are generally of a reconnaissance level to give a broad-scaled analysis of future requirements for development of fish and wildlife resources throughout the basin. More detailed data are presented in those instances where the need identified is more immediate and will require specific action within the initial development period.



## RELATIONSHIP TO OTHER PARTS OF REPORT

This appendix relies upon data contained in the three supporting appendices--Study Area, Hydrology, and Economic Base. It is also specifically related to some of the functional appendices. Data in this and other appendices are used interchangeably. For example, the suitability of habitat for fish and wildlife is highly dependent upon the quality of water and adjacent land, which are covered in Appendix L. Sport fishing and hunting, although forms of recreation, are discussed in this appendix rather than in Appendix K - Recreation.

Fish and wildlife are also related to other functions of water resource development. Changes in land use through irrigation or drainage, for example, affect the environment either in a positive or negative sense, depending on species inhabiting the area. Consumptive uses of water affect fish and in some cases wildlife environments by removing water from the point of use.

The relationship of fish and wildlife to all other project functions of multipurpose resource development is covered in detail in the Plan Formulation Appendix. Data from this (Fish and Wildlife) appendix are used in plan formulation studies as well as to provide a background for the fish and wildlife discussion in the main report.

# H I S T O R Y

For many hundreds of years previous to white occupancy, the Indians of the Willamette and Columbia River valleys traded dried salmon, trout, smelt, and sturgeon to other tribes. Major fishing areas such as Willamette Falls supported permanent villages, but most of the population lived a semi-nomadic existence and depended on occasional fishing, hunting, and gathering of camas and wapato for subsistance. There are no records as to the numbers of fish and game required for the Indians' subsistance, but Craig and Hacker in "The History and Development of the Fisheries of the Columbia River" estimated that the salmon and steelhead catch during this period was about 18,000,000 pounds annually from Columbia River and its tributaries.

The early explorers found dense coniferous timber covering the foothills and the slopes of the Cascade and Coast Ranges, but the valley floor was mostly open grasslands with scattered clumps of trees marking low spots and water courses. Open forests of oak occurred in some areas. There was relatively little game in the densely forested area, but the valley abounded with it. White-tailed deer, black-tailed deer, elk, and both black and grizzly bears were numerous. The many bottomland sloughs and marshes supported ducks, geese, swans, and other waterfowl. Brush rabbits, silver gray squirrels, blue and ruffed grouse, mourning doves, mountain quail, and band-tailed pigeons were also present. Fur animals--beavers, otters, minks, martens, fishers, muskrats, weasels, raccoons, and other species--were present in great numbers.

Photo I-1. *Early settlers, fur trappers, and mountain men met at Champoeg to discuss the problem of wolves destroying livestock. From these "wolf meetings" evolved the first provisional government. State Capitol mural. (Oregon State Highway Department photo)*

Fish resources were abundant in Willamette Basin. Resident fish such as rainbow and cutthroat trout and anadromous fish such as steelhead and spring chinook salmon were important species. Fall chinook salmon were almost unknown in the basin above Willamette Falls because they were unable to surmount this barrier during the low flow period. Clackamas and Sandy Rivers contained nearly the entire fall chinook run migrating into the study area.

The primary significance of Willamette Basin from a fisheries standpoint has been its role as a spawning ground for anadromous fish of Columbia River. Because of data limitations, what percentage of Columbia River anadromous fish spawned in Willamette Basin is unknown, but early fishermen found it profitable to operate in lower Willamette and Clackamas Rivers for many years before these streams were closed to commercial fishing. It is certain that Willamette Basin has contributed materially to the Columbia River salmon canning and processing industries over the years, both from direct harvest within the basin and from basin-spawned fish caught farther downstream or in the ocean.

*Photo I-2. Beach seining was a productive method of salmon fishing until outlawed in 1948. (Oregon Historical Society photo)*

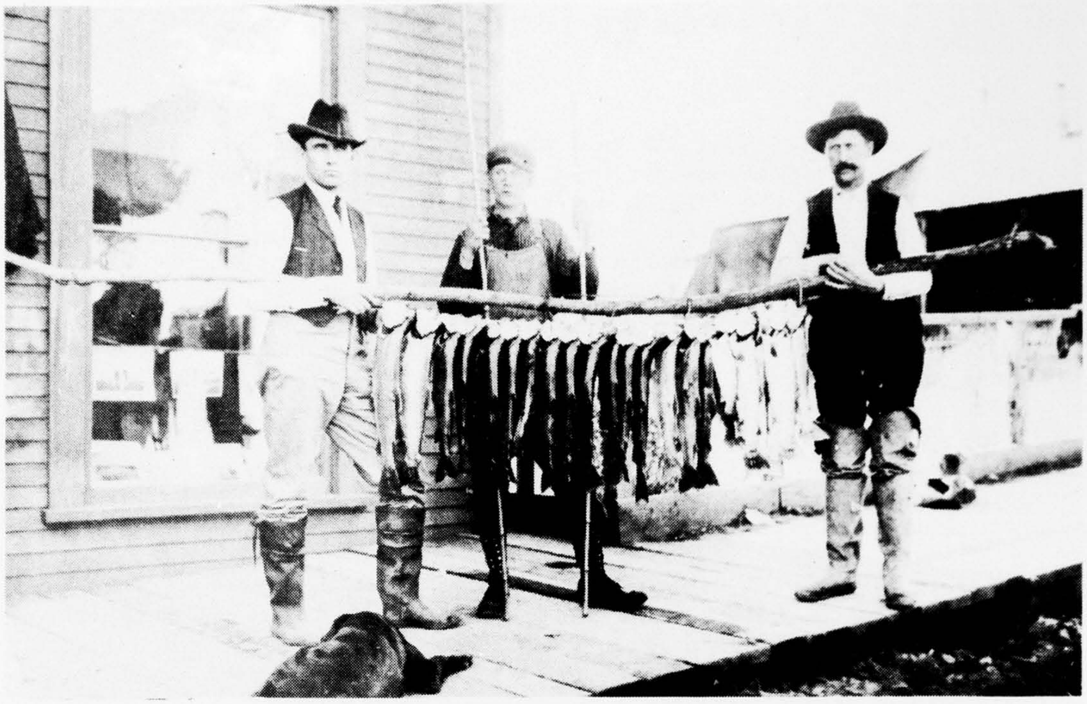


*Photo I-3. These early-day sport fishermen were probably happier than they look. (Oregon Historical Society photo)*

*Photo I-4. Salmon fishing was popular in the lower Willamette at the turn of the century. (Oregon Historical Society photo)*

## R E S O U R C E   U T I L I Z A T I O N

### FISH

The commercial possibilities of preserved salmon were realized early in the fur trading days. Many trading vessels entering the lower Columbia River in the early nineteenth century packed salmon for use on the return voyage. By 1830, several concerns were pickling (salting) salmon on the lower Willamette River for export.

The first salmon cannery on Columbia River was set up in 1866. By 1883, 39 canneries were operating and 43,000,000 pounds of salmon were taken, practically all spring chinook. The 1911 catch of 49,480,000 pounds was the largest on record, but contained a much larger proportion of coho and steelhead trout than the 1883 catch. New freezing processes and improved means of transportation have diverted much of the catch in recent years from canning and various forms of salting to the fresh and fresh-frozen markets.

Other Willamette River fish that have entered the commercial fishery are sturgeon, Columbia River smelt, shad, crayfish, and Pacific lamprey. Sturgeon fishing reached its peak in 1892, but then declined rapidly and has since remained at a low level. Smelt have rarely migrated into Willamette River, but have run in huge numbers up Sandy River. The last Sandy River smelt run was in 1957, but there were runs in 27 of the previous 38 years. Economic value of the other species has been relatively low.

Willamette Basin was a fabulous sport fishing area in the latter part of the 19th Century and the first part of the 20th. Many famous sportsmen came to fish, particularly at Willamette Falls. In the early days there were no seasons, limits, nor license requirements, and until well into this century, the catch could be sold. Bag limits, when established, were huge by present standards, 125 trout per day at the turn of the century.

*Photo I-5. Early salmon canning and processing plant. (Oregon Historical Society photo)*

WILDLIFE

Before the rush of settlement in the 1840's, Willamette Valley was a favored hunting area. During the fur trade period, beaver and other fur animals were intensively trapped, and deer, elk, and smaller game were hunted for use at the trading posts. During the early settlement period, a large portion of the settlers' subsistence came from the fish and wildlife of the area. Market hunting in the basin continued well into the present century.

Principal upland-game species before the 1880's were brush rabbits, snowshoe hares, silver gray squirrels, blue and ruffed grouse, and mountain quail, of which blue grouse were probably the most sought-after. Ring-necked pheasants were introduced into Willamette Valley in 1881, the first successful pheasant introduction into the United States. Shortly thereafter pheasant populations "erupted" in the valley and remained extremely high for the next 20 years or longer. Populations are high in only limited areas of the valley now, but pheasants still rank as the No. 1 upland-game species so far as hunter-day use is concerned. Bobwhites, Hungarian partridges, California quail, and cottontails were subsequently introduced into the basin, but except for California quail, are not hunted to any great extent.

Journals of early fur traders mention large numbers of ducks, geese, and swans in Willamette River and in lakes and sloughs along the river. Sandhill cranes were also a numerous and eagerly sought species. The huge flocks of waterfowl noted in the journals are no longer here, but relatively large numbers still winter on Willamette Valley lands.

Photo I-6. Professional hunters operated until well into this century. (Oregon State Library photo)

## EFFECTS OF SETTLEMENT AND DEVELOPMENT

Fish and wildlife require preservation of environmental quantities and qualities for survival. Declines in fish and wildlife populations caused by overharvesting are usually temporary and reversible. Declines resulting from destruction of habitat are generally permanent except in some instances where habitat can be restored. In general, settlement and development has been detrimental to the fish and wildlife habitat.

### FISH

Late in the nineteenth century, factors adversely affecting fish habitat began to increase in severity. Logging, dam construction, and pollution made the primary inroads.

At this time also, over-fishing and excessive egg-taking probably caused declines in some of the anadromous fish runs.

Logging practices employed in the early years had baneful effects. Splash and roll dams and debris from cutting activities brought about blockage of streams, ruination of spawning areas, and other undesirable results. Present systems of logging have improved the situation, but tremendous amounts of debris remain in some stream bottoms and erodable forest roads still contribute silt to basin streams.

Since 1900, a considerable number of dams and reservoirs have been constructed in the basin. These have been a mixed blessing from a fisheries standpoint. On the favorable side, some have furnished cooler water downstream and augmented normal flows during the summer, and have controlled floods and thereby reduced siltation and loss of downstream migrants. Some of the reservoirs have probably furnished more man-days of fishing than the stream area they replaced. On the other hand, stream fishing and spawning areas in the reservoirs basins have been destroyed and upstream spawning areas are no longer accessible except where passage facilities have been provided. Flooding or drying out of spawning areas, raising of water temperatures, and losses of downstream migrants have also occurred as a result of reservoir operation.

For many years, the lower Willamette River has frequently been polluted during low flow periods in summer and fall to the extent that anadromous fish would not migrate through this reach. On occasion it has been lethal to local populations. Many pollutants are present including but not limited to soil sediments, sawmill and cannery wastes, raw sewage, and sulphite pulp liquor--the greatest single source of pollution affecting fishery resources. Calapooia River, Lower Scappoose Creek, Pudding River, Tualatin River, Yamhill River, Rickreall Creek, Santiam and South Santiam Rivers, Long Tom River, and other streams of the basin also exhibit gross pollution.

Habitat impairment and overharvesting reduced wildlife populations during the period of white settlement. By the early 1900's, white-tailed deer and elk had been nearly exterminated. Some fur animals were over-trapped and nearly wiped out early in the fur trading days. Waterfowl numbers declined severely through destruction of habitat.

Under management, the populations of some species have rebounded, but less habitat is available than formerly for most species. Drainage of marshlands, increased water pollution, and urban expansion are three examples of the habitat destruction which has taken place in the past 100 years or more.

*Photo I-7. Three apiece and all bucks. (Oregon Historical Society photo)*

## FISH

State, Federal, and, to some extent, private agencies have been attempting since before the 1880's to conserve or reestablish anadromous fish runs in the Willamette and Sandy River systems. Various legal limitations and hatchery programs were among the means used to effect these ends.

The first hatchery, on Clackamas River, was constructed in 1877 by a private concern and was turned over to the Federal Government about 10 years later. More salmon and steelhead hatcheries and experiment stations were built in the intervening years and at present there are 9 in the basin--8 operated by the State, and one by the Federal Government. In recent years, 3 trout hatcheries have also been operated by the State in Willamette Basin. Three of the salmon and 2 of the trout hatcheries operated by the State were constructed and are financed by the Corps of Engineers under terms of the original Willamette Basin Program.

Oregon began to regulate commercial salmon and steelhead fisheries in 1878 when the Legislature established a closed season and limited the mesh size used in nets and traps. Ten years later, the commercial fishing area in Willamette Basin had been limited to the lower parts of Willamette and Clackamas Rivers. Further restrictions were subsequently placed on gear and open areas, and in 1927, Willamette River Basin was closed to commercial fishing for salmon and steelhead.

Bag limits and license requirements were established to regulate the drain on the sport fishery. The daily trout limit was reduced to 50 in 1917, and in recent years has been 10. The first fishing licenses, both resident and nonresident, were issued in 1909.

At the turn of the century, most of the laws regulating pollution in Willamette Basin were aimed at sawmill operators who were dumping sawdust and other wood wastes into the streams. Since then, water quality standards have been established and there has been much progress toward control, but pollution is still one of the major factors limiting fish production in many streams of the study area.

## WILDLIFE

The first game farm was established near Corvallis in 1911 by the State of Oregon. The same year the Legislature passed a law enabling establishment of refuges on private lands under cooperative agreement with the landowners, and around State institutions. Under this law, several refuges were developed and some are still in existence. The State now owns or controls 5 wildlife management areas in Willamette Basin encompassing over 19,000 acres; the largest of these is Sauvie Island Game Management Area, 10,963 acres. Three small National Wildlife Refuges were established in 1964, primarily for the protection of dusky Canada geese, but to provide protection for other species as well. The refuges will include approximately 10,700 acres in 3 separate areas. Wildlife areas on private lands have been expanding during the last quarter-century.

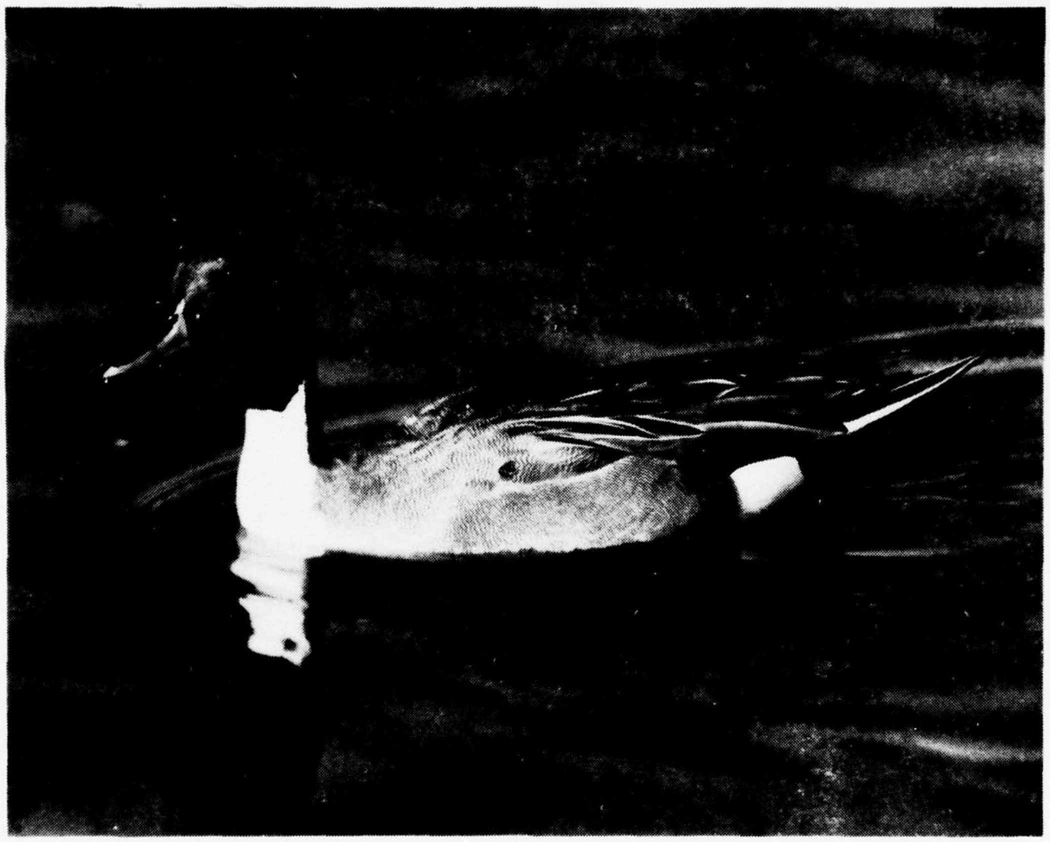


*Photo I-8. A pin on a pond. (Bureau of Sport Fisheries and Wildlife photo)*

PRESENT STATUS

The material contained in Part II, Present Status, is divided into separate "Fisheries" and "Wildlife" sections. This division was made to facilitate the evaluation of these resources.

FISH

WILDLIFE

# FISH

## BACKGROUND STUDIES

Willamette Basin Study Area contains between 9,000 and 10,000 miles of streams, at least 565 named lakes, and approximately 33,000 acres of reservoirs. Its lakes range from warm water ponds to cold, clear tarns; its streams from polluted rivers to clear brooks. Fish produced in the basin are caught not only within the basin, but in Columbia River, along the shore of the Pacific Ocean from Alaska to California, and in Puget Sound waters. This vast mix of organisms and environments had been studied piecemeal for years, but early in Willamette Review Study biologists assigned to the investigation realized that large and critical gaps existed in the store of knowledge essential to a truly comprehensive study of the fish resources. It became apparent that neither time nor money were available with which to gather all the information that could be used. It was decided that only the most essential studies to correct critical data deficiencies could be undertaken.

One of the principal voids involved the amount of use by sport fishermen on the resident fish of the basin. Although fairly acceptable information was available on use and harvest from some local areas, no overall assessment of fisherman use of Willamette Basin waters had ever been made. The deficiency was corrected when Bureau of Commercial Fisheries contracted with Oregon State Game Commission and Oregon State University for a study of fisherman use and harvest in the basin. This resulted in publication in 1966 of Survey of Angler Effort in Oregon in 1965, by Lyle D. Calvin and T. D. Burnett, a contribution of the Department of Statistics of the University.

A large amount of data on fish habitat in the basin had been gathered in previous years, particularly as a result of studies by Fish Commission of Oregon in cooperation with Bureau of Commercial Fisheries under the Columbia River Fisheries Development Program. A concentrated effort was instituted by Oregon State Game Commission, Fish Commission of Oregon and Bureau of Commercial Fisheries personnel to fill the major gaps in this data. One result of this cooperative effort was publication of A Physical Inventory of Streams in the Upper Willamette Watershed above the Confluence of Middle and Coast Forks of the Willamette River by Kenneth E. Thompson, Oregon State Game Commission, 1964.

Use of spawning habitat in the basin, particularly by coho salmon and steelhead trout, was imperfectly known because complete counts of the escapement of these species over Willamette Falls were not obtained and because no overall spawning ground surveys had ever been made. Complete counts were made for the first time during the 1965-1966 seasons. In addition, Fish Commission of Oregon, Oregon State Game Commission and Bureau of Commercial Fisheries personnel made intensive spawning ground studies in the spring of 1966. These studies resulted in publication of Aerial Surveys for Steelhead Trout Spawning in the Willamette River Basin, by Fish Commission of Oregon, 1966 and Number

and Distribution of Steelhead Trout Spawning in the Willamette Basin in 1966, by James M. Hutchison, K. E. Thompson, and G. J. Hattan, Oregon State Game Commission, 1966.

As a result of these studies, similar special studies conducted in the past and such routine investigations as creel census studies, salmon and steelhead punch card analyses and commercial fish harvest data compilations, it has been possible to assemble data with which to estimate numbers of fish, amount of fisherman use, and other basic information included in this appendix.

FISH AND FISH HABITAT OF WILLAMETTE BASIN STUDY AREA

Fishes of the basin and a rough approximation of their abundance are shown in Table II-1. These fishes are discussed under four general groupings in the appendix: Anadromous fish - those that spend part of their lives in the ocean but return to fresh water to spawn, including salmon, steelhead and searun cutthroat trout, eulachon, and American shad; cold-water game fish - the trouts, kokanee, white sturgeon, and mountain whitefish; warm-water game fish - the bass, catfish and panfish of the basin; nongame fish - all the rest. Both anadromous and resident races of rainbow trout (steelhead), cutthroat trout (searun cutthroat) and sockeye salmon (kokanee) occur in the basin. The lampreys, although anadromous, are regarded as nongame fish.

Table II-1
*Fishes of Willamette Basin*

| Scientific Name | Common Name | Abundance |
|---|---|---|
| Petromyzontidae | | |
| *Lampetra planeri* | Western brook lamprey | High |
| *Lampetra tridentata* | Pacific lamprey | High |
| Acipenseridae | | |
| *Acipenser transmontanus* 1/ | White sturgeon | Moderate |
| Clupeidae | | |
| *Alosa sapidissima* 1/ 2/ | American shad | High downstream from Willamette Falls; low upstream from Falls. |
| Salmonidae | | |
| *Oncorhynchus keta* 1/ | Chum salmon | Low |
| *Oncorhynchus kisutch* 1/ | Coho salmon | Moderate |
| *Oncorhynchus nerka* 1/ 2/ | Sockeye salmon or kokanee | Low |
| *Oncorhynchus tshawytscha* 1/ | Spring chinook salmon | Moderate to high |
| *Oncorhynchus tshawytscha* 1/ | Fall chinook salmon | Low |
| *Prosopium williamsoni* 1/ | Mountain whitefish | Low to moderate |
| *Salmo aquabonita* 1/ 2/ | Golden trout | Low |
| *Salmo clarki* 1/ | Cutthroat trout | High |
| *Salmo gairdneri* 1/ | Rainbow (steelhead) trout | Moderate |
| *Salmo salar* 1/ 2/ | Atlantic salmon | Low |
| *Salmo trutta* 1/ 2/ | Brown trout | Low |
| *Salvelinus fontinalis* 1/ 2/ | Brook trout | Low |
| *Salvelinus malma* 1/ | Dolly Varden | Low |
| *Salvelinus namaycush* 1/ 2/ | Lake trout | Low |
| Osmeridae | | |
| *Thaleichthys pacificus* 1/ | Eulachon (smelt) | High in Sandy R. some years. None since 1957. |

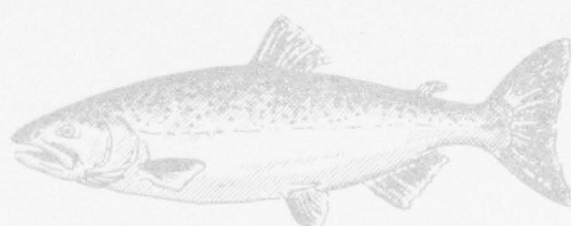


Table II-1 (Cont'd)

| Scientific Name | Common Name | Abundance |
|---|---|---|
| Cyprinidae | | |
| *Acrocheilus alutaceus* | Chiselmouth | High |
| *Carassius auratus* 2/ | Goldfish | Low |
| *Cyprinus carpio* 2/ | Carp | High |
| *Hybopsis crameri* | Oregon chub | Low |
| *Mylocheilus caurinus* | Peamouth | Moderate |
| *Ptychocheilus oregonensis* | Northern squawfish | High |
| *Rhinichthys cataractae* | Longnose dace | High |
| *Rhinichthys falcatus* | Leopard dace | High |
| *Rhinichthys osculus* | Speckled dace | High |
| *Richardsonius balteatus* | Redside shiner | High |
| *Tinca tinca* 2/ | Tench | Low |
| Catostomidae | | |
| *Catostomus macrocheilus* | Largescale sucker | High |
| *Pantosteus platyrhynchus* | Mountain sucker | High upstream from Corvallis; low in downstream areas |
| Ictaluridae | | |
| *Ictalurus melas* 1/ 2/ | Black bullhead | (Unauthenticated reports) |
| *Ictalurus natalis* 1/ 2/ | Yellow bullhead | Moderate |
| *Ictalurus nebulosus* 1/ | Brown bullhead | Moderate |
| *Ictalurus punctatus* 1/ 2/ | Channel catfish | Low to moderate |
| Gasterosteidae | | |
| *Gasterosteus aculeatus* | Threespined stickleback | High |
| Poeciliidae | | |
| *Gambusia affinis* 2/ | Mosquitofish | Low to moderate |
| Percopsidae | | |
| *Percopsis transmontana* | Sand roller | Low to moderate |

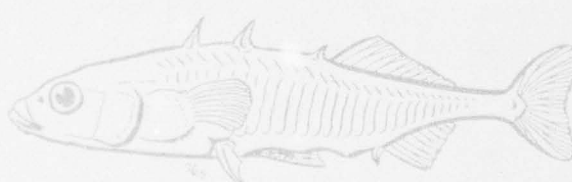


Table II-1 (Cont'd)

| Scientific Name | Common Name | Abundance |
|---|---|---|
| Centrarchidae | | |
| *Chaenobryttus gulosus* 1/ 2/ | Warmouth | High |
| *Lepomis gibbosus* 1/ 2/ | Pumpkinseed | High |
| *Lepomis macrochirus* 1/ 2/ | Bluegill | High |
| *Micropterus dolomieui* 1/ 2/ | Smallmouth bass | Moderate |
| *Micropterus salmoides* 1/ 2/ | Largemouth bass | High |
| *Pomoxis annularis* 1/ 2/ | White crappie | High |
| *Pomoxis nigromaculatus* 1/ 2/ | Black crappie | High |
| Percidae | | |
| *Perca flavescens* 1/ 2/ | Yellow perch | High |
| Cottidae | | |
| *Cottus asper* | Prickly sculpin | Low |
| *Cottus bairdi* | Mottled sculpin | Low |
| *Cottus beldingi* | Piute sculpin | Moderate |
| *Cottus perplexus* | Reticulate sculpin | Moderate |
| *Cottus rhotheus* | Torrent sculpin | Low |

*1/ Species defined as "game fish" in 1965-66 Oregon Game Code.*
*2/ Introduced species, others are indigenous to Willamette Basin.*

*Note: This table was constructed with the assistance of Dr. Carl E. Bond, Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon. The terms "low", "moderate," and "high" refer to the relative abundance of a species as compared to the other listed species, particularly those of the same family.*

The production of fish in Willamette Basin is limited by both natural and artificial factors. The amount of spawning and rearing habitat available is a finite limitation on the number of fish that can be produced naturally. The principal natural limiting factors are low streamflows and barriers, such as falls and cataracts, that impede the movements of fish. Several of the principal artificial limiting factors are similar, in a sense, to the adverse natural factors. Dams limit the movement of fish; other uses of water contribute to low streamflow conditions. Almost without exception, each dam, each water diversion, each pollutant entering the basin's water reduces production and rearing habitat for some species of fish. Contrariwise, water development projects frequently can be operated to produce beneficial effects by modifying limiting factors. Many reservoirs produce more sport fishing (though usually of lower quality) than the stream reaches they inundate. Some species of fish, kokanee for example, require lake or reservoir habitat to survive. It has been possible to establish populations of these fish in some areas of Willamette Basin where they could not possibly live under preproject conditions. Under some circumstances, reservoirs may be operated to release cold water during summer and fall when natural flows are critically low and warm. Stored water has been released in Willamette Basin to dilute pollution during periods when dissolved oxygen concentrations in the lower reaches were at extremely low levels. The flood control effects of some reservoirs have benefitted fish by reducing siltation of spawning gravel, reducing erosion of redds (nests excavated by the spawning fish) and stranding of young fish. Fish enhancement is not authorized as a project purpose for any of the constructed water development projects. This restricts the ability of these projects to produce fishery benefits.

Fish passage facilities have been constructed at several falls and cataracts in the basin. The largest project of this kind, which will eliminate one of the major factors limiting anadromous fish production, is Willamette Falls Fishway. The falls had probably always restricted fish passage, particularly during low water flow periods, but a dam constructed around the lip in 1903 or 1904 blocked all passage. Efforts to provide fish passage between 1904 and 1965 were only partially successful, and large amounts of potentially good anadromous fish habitat remained unused. Fish-passage facilities are being constructed at the falls under the Columbia River Fishery Development Program of the Bureau of Commercial Fisheries in cooperation with Fish Commission of Oregon and industries at the falls. The first section of the fishway became operative in 1968. When passage facilities are completed, a major factor limiting anadromous fish production in the basin will be eliminated. Meetings are being held to determine the type of passage for downstream migrants.

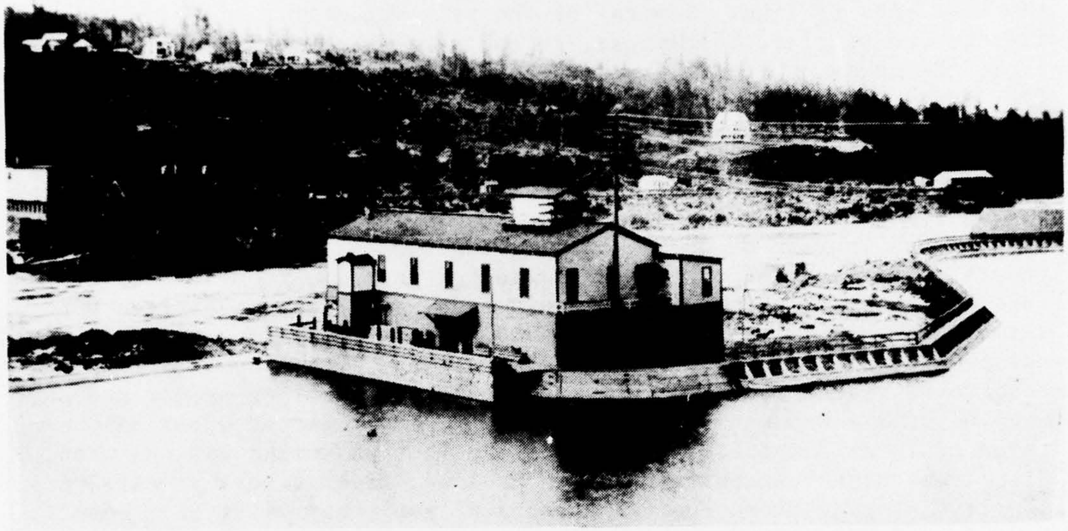


*Photo II-1. Willamette Falls development blocked fish passage at the turn of the century. (Oregon State Library photo)*

The Fish Commission of Oregon, Oregon State Game Commission and U.S. Fish and Wildlife Service in anticipation of improved passage at the falls instituted a program of massive plantings of anadromous fish in the basin. This insured that runs of fish would increase at a higher rate than would naturally occur, and that runs of species heretofore blocked by the falls could be established. Table II-2 illustrates the planting program in the basin undertaken by the fisheries agencies before passage conditions were improved.

Table II-2
*Numbers of anadromous fish stocked, by species, 1961 to 1965 (in thousands)*

| Species | 1961 | 1962 | 1963 | 1964 | 1965 | Total |
|---|---|---|---|---|---|---|
| Fall Chinook | 6,183 | 6,869 | 4,658 | 18,700 | 14,185 | 50,595 |
| Spring Chinook | 4,598 | 3,272 | 5,536 | 15,515 | 6,191 | 35,112 |
| Coho | 3,572 | 4,325 | 9,289 | 4,147 | 12,604 | 33,937 |
| Steelhead Trout | 1,025 | 1,570 | 1,394 | 1,008 | 739 | 5,736 |
| Totals | 15,378 | 16,036 | 20,877 | 39,370 | 33,719 | 125,380 |

Waters of Willamette Basin are not productive enough to furnish all the resident cold-water fish required by the sport fishery at its present level of excellence. Large numbers of trout are planted each year, mostly by Oregon State Game Commission, to partially supply the demand for sport fishing in the basin (Table II-3).

Table II-3
*Numbers of cold-water game fish stocked, by species, 1961 to 1965 (in thousands)*

| Species | 1961 | 1962 | 1963 | 1964 | 1965 | Total |
|---|---|---|---|---|---|---|
| Rainbow Trout | 4,164 | 3,462 | 4,596 | 2,901 | 3,568 | 18,691 |
| Brook Trout | 712 | 1,045 | 616 | 482 | 434 | 3,289 |
| Cutthroat Trout | 23 | 103 | 126 | 62 | 80 | 394 |
| Golden Trout | 1 | 11 | 6 | 6 | 0 | 24 |
| Kokanee | 490 | 329 | 732 | 432 | 968 | 2,951 |
| Totals | 5,390 | 4,950 | 6,076 | 3,883 | 5,050 | 25,349 |

Anadromous salmonids will be considered in greater detail in this appendix than will any of the other groups of fishes because they are the most valuable fish of the basin in terms of both commercial catch and sport fisherman use. They also have the greatest potential for increase in natural environment, are the most widely distributed, and have received the most intensive study of all the basin's fish. Both in Willamette Basin and elsewhere, natural limiting factors, water development projects, urban and industrial development, and land use practices have had greater adverse effects on these than on resident species.

The spawning escapement of these fish into study area waters in the 1965-1966 season was estimated to be 58,000 coho, 36,500 spring chinook, 7,300 fall chinook and 26,000 steelhead trout. These figures do not include jacks which are precocious male salmon that return from salt water as a mature fish 1 or 2 years before their normal run. The 1965 commercial catch of anadromous salmonids produced in Willamette Basin waters, but harvested elsewhere, was estimated to be 2,983,000 pounds of fish valued at $1,540,000. The sport fisherman use of fish produced in the study area was estimated at 539,000 days valued at $3,234,000. Sport use of American shad and white sturgeon was estimated to be 39,000 days valued at $117,000.

The study area contains thousands of miles of streams, hundreds of mountain lakes and dozens of reservoirs. Nearly all these waters furnish sport fishing for cold-water species of fish. In 1965, the stream trout fishery furnished an estimated 473,000 angler days of use valued at $1,419,000. Lakes and reservoirs for which data were available furnished 431,000 days valued at $862,000.

Warm-water game fish are found in the Willamette, the lower reaches of many tributary streams, in many low-elevation lakes and ponds, and in several of the large flood control reservoirs. The 1965 fisherman use of these species was estimated to be 89,700 days valued at $133,000. This figure is conservative because it does not include the active fisheries in the Columbia Slough-Sauvie Island area.

*Photo II-2. The study area contains many miles of streams that furnish sport fishing for coldwater species of fish. (Bureau of Sport Fisheries and Wildlife photo)*

## ECONOMIC CONSIDERATIONS

Certain aspects of water resource planning require assignment of monetary values to resource use. A basis for measurement of sport fishing activity is the fisherman-day unit. The value of each unit may be defined as the rent that could be charged for the privilege of fishing if all fishing rights were controlled by a single monopolist. They represent net economic values over and above actual expenditures by sportsmen.

Sport fisherman day unit values used in this appendix are: salmon and steelhead fishing, $6 per day; white sturgeon, American shad, and cold water stream fishing, $3 per day; cold water lake and reservoir fishing, $2 per day; fishing for warm-water species, $1.50 per day. These are within the range of values prescribed in Evaluation Standards for Primary Outdoor Recreation Benefits 1/, and are professed to be comparable to net values for other water development project benefits. In actuality, most of these values have not changed since first adopted in 1960 2/, and were at that time considered by many biologists to considerably undervalue the resource.

A recent unpublished preliminary study by Bureau of Commercial Fisheries 3/ indicates for salmon and steelhead from the Columbia River and its tributaries, the net economic value, 1962 to 1964, was $8.87 per fish. This study draws heavily on Brown's 4/ 1964 paper, and indicates that Oregon anglers spent $51.14 to catch a salmon or steelhead in 1962, not including expenditures for licenses or salmon-steelhead punch cards. The study also explores Knetsch's 5/ method of calculating net economic value and concludes that under his system, the net value per fish would be over two and one-half times the $8.87 calculated using Brown's equations.

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1/ Ad Hoc Water Resources Council, Supplement No. 1 to Senate Document 97, Policies, Standards and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources, 1964.

2/ Inter-Agency Committee On Water Resources, Report of the Panel on Recreational Values on a Proposed Interim Schedule of Values for Recreational Aspects of Fish and Wildlife, 1960.

3/ Norton, Virgil J., William G. Brown, and Jack A. Richards, An Economic Evaluation of Columbia River Anadromous Fish Programs, A Preliminary Study, Bureau of Commercial Fisheries, (1967).

4/ Brown, William G., Ajmer Singh, Emery N. Castle, An Economic Evaluation of the Oregon Salmon and Steelhead Sport Fishery, Oregon State Game Commission, 1964.

5/ Knetsch, Jack L., Economics of Including Recreation as a Purpose of Eastern Water Projects, Journal of Farm Economics, December 1964.

Such studies indicate that the sport fishing values expressed in this appendix are conservative estimates. They should be considered as only a part of the total tangible and intangible values that could be assigned to the resource. The intangible values are, by definition, those that cannot be monetarily measured. The other tangible values that could be considered, such as the meat value of the catch, the enhancement of land values attributable to the presence of the fish, and secondary values such as the net profit from the sale of fishing equipment have not been considered in this evaluation.

The commercial fishery is bound by legal restraints to a system of inefficient harvest. Since the number of fish that can be harvested is limited, and the number of fishermen is not, it is nearly always a marginal operation.

Unit values used in this appendix to evaluate the sport fishery were issued in 1964. The indicated commercial catch values are derived from the ex-vessel prices received by fishermen, and for this study were calculated from the following 1965 average values per pound: Chinook salmon - \$.56, coho - \$.39, and steelhead trout - \$.30. Neither sport nor commercial values reflect price increases subsequent to these dates.

*Photo II-3. Gill net fishing on the Columbia. (Fish Commission of Oregon photo)*

The present status of the fish resources of the study area including species, habitat, population, use, and value are discussed in some detail by subbasins in the following sections. Willamette River, which extends from the confluence of the Coast and Middle Forks to the river mouth, has been treated separately to avoid the necessity of describing individual sections of the river which border, or pass through subbasins. Information concerning sloughs and oxbow lakes closely associated with Willamette River is also incorporated in this section.

*Photo II-4. Spinning gear and a limit of rainbow trout. (R. J. Fischer photo)*

# WILLAMETTE RIVER

## Habitat

Approximately 11,200 square miles are drained by the Willamette River system. The river flows north for 187 miles before entering Columbia River near Portland. Stream gradient is low, from about 12 feet per mile near Eugene to less than 0.1 foot per mile below Willamette Falls.

Average river discharge, recorded by the U.S. Geological Survey's Wilsonville gage at river mile 38.5 from September 1948 to October 1965, was 29,400 cubic feet per second. Extremes during this interval were 3,600 cfs in November 1952 and 339,000 cfs in December 1964. This gage, the lowermost on the river, is located upstream from the mouths of Clackamas, Tualatin, Molalla, and Pudding Rivers.

Willamette River serves as a route for the upstream and downstream migration of anadromous fish. Table II-4, showing percentage of migration by month for each species, indicates that the river is important in this role at all times of the year.

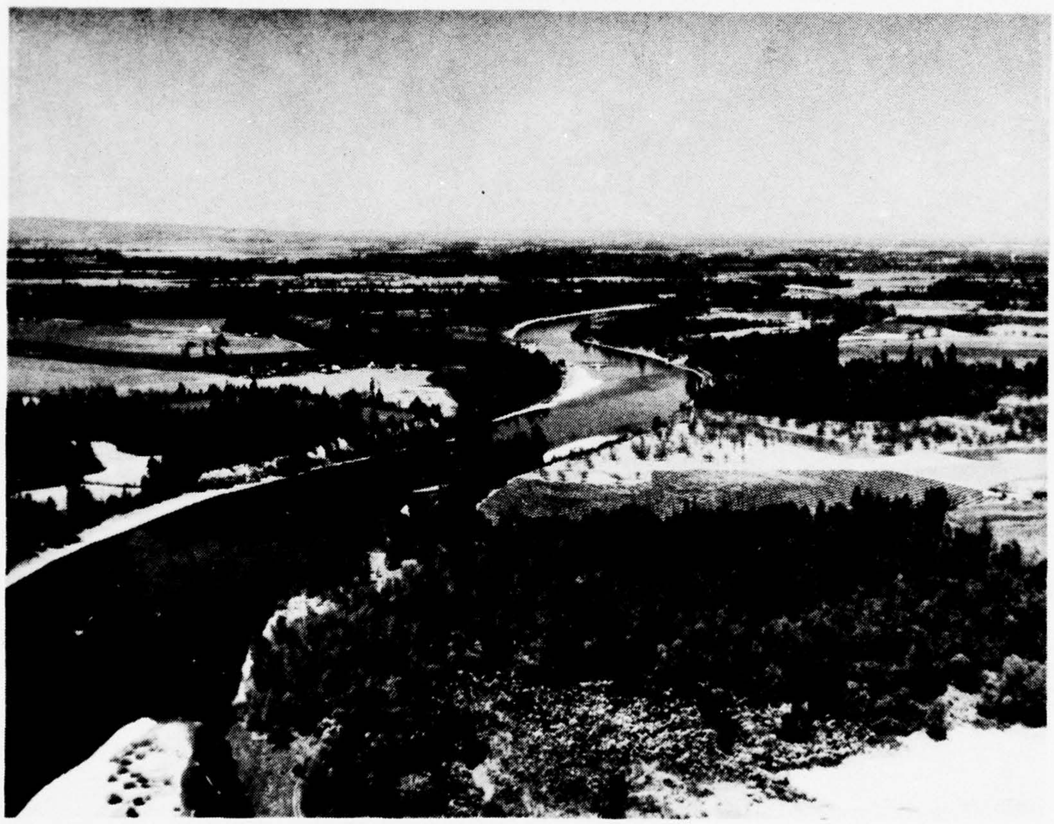


*Photo II-5. Willamette River--a migration route for anadromous fish. (Oregon State Highway Department photo)*

Table II-4

*Periodicity of adult and juvenile anadromous fish migration over Willamette Falls as percent of average annual migration by month*

| Species | Age | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Upstream Migrants 1/** | | | | | | | | | | | | | |
| Coho Salmon | Adult | | | | | | | | | 16.1 | 65.1 | 18.6 | 0.2 |
| Spring Chinook | " | | | | 18.6 | 75.6 | 5.8 | | | | | | |
| Winter Steelhead | " | | 5.9 | 9.5 | 76.6 | 7.3 | 0.2 | 0.2 | | | | 0.1 | 0.2 |
| Shad 3/ | " | | | | | | | | | | | | |
| **Downstream Migrants 2/** | | | | | | | | | | | | | |
| Coho Salmon | Juv. | | | 0.1 | 28.7 | 43.2 | 24.0 | 3.9 | | | | 0.1 | |
| Spring Chinook | " | 0.6 | 1.1 | 6.7 | 13.1 | 14.6 | 39.3 | 21.0 | 0.3 | 1.6 | 0.8 | 0.3 | 0.6 |
| Winter Steelhead | " | 0.1 | 0.3 | 18.0 | 57.4 | 21.5 | 1.5 | | | | 0.5 | 0.6 | 0.1 |
| | Adult | | | 0.2 | 4.6 | 56.8 | 35.1 | 3.3 | | | | | |
| Shad | Juv. | | | | | | | | 0.7 | 5.8 | 75.1 | 17.5 | 0.9 |
| | Adult | | | | | | 18.0 | 11.7 | | 3.2 | 20.2 | 24.5 | 22.4 |

1/ *Based on counts by Fish Commission of Oregon between 1957 and 1966.*
2/ *Based on downstream migrant study by Oregon State Game Commission, 1964-66.*
3/ *No counts available, peak upstream passage occurs in June and July.*

Willamette River furnishes abundant spawning and rearing habitat for anadromous fish, especially fall chinook. The supply of spawning gravel is good upstream from Newberg, and is particularly plentiful upstream from Corvallis. In 1967, fall chinook spawned from Salem upstream. The stream may be important for rearing throughout the winter, but pollution and warm water temperatures limit rearing of steelhead and spring chinook during low-flow months. Fall chinook migrate downstream before low flows become critical so rearing of this species is not affected.

The optimum water temperature for salmonid rearing is between 45° and 60°F. However, Willamette River temperatures exceed the upper limit throughout most summer periods. Frequently, water temperatures exceed 65°F. in the upper river and 70°F. in the lower river. Water this warm favors survival of predators and competitors of salmon and trout. Table II-5 lists temperature and dissolved oxygen data obtained at 5 sites along the Willamette in summer. These measurements were made once a week at various times of day and, therefore, do not represent true averages or extremes.

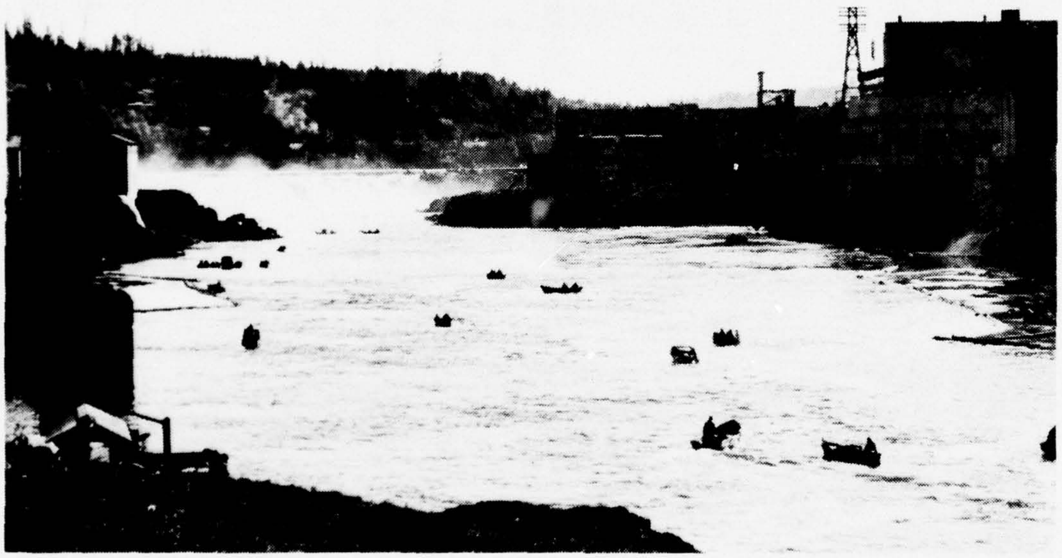


*Photo II-6. Willamette Falls, and a few sport fishermen.*

Table II-5

*Willamette River temperature and dissolved oxygen data for July, August, and September, 1953-65 1/*

| Year | Springfield, River mile 185.0 | | Independence, River mile 95.0 | | Newberg, River mile 50.0 | | Marina Mart, River mile 27.0 | | S.P. & S., River mile 7.0 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Temperature (°F) | | | | | | | | | |
| | Mean | Max. | Mean | Max. | Mean | Max. | Mean | Max. | Mean | Max. |
| 1953 | 68 | 68 | 68 | 72 | 70 | 73 | 72 | 75 | 68 | 73 |
| 1954 | 59 | 61 | 64 | 68 | 68 | 70 | 68 | 72 | 66 | 72 |
| 1955 | 59 | 59 | 61 | 61 | 64 | 64 | 68 | 73 | 66 | 72 |
| 1956 | 64 | 64 | 68 | 70 | 70 | 77 | 70 | 75 | 70 | 77 |
| 1957 | 64 | 68 | 68 | 70 | 70 | 73 | 70 | 73 | 70 | 73 |
| 1958 | 63 | 68 | 70 | 79 | 72 | 79 | 73 | 79 | 73 | 81 |
| 1959 | 64 | 66 | 66 | 75 | 68 | 79 | 70 | 79 | 68 | 79 |
| 1960 | 64 | 68 | 70 | 73 | 70 | 75 | 70 | 75 | 68 | 75 |
| 1961 | 61 | 63 | 68 | 75 | 70 | 77 | 70 | 75 | 70 | 77 |
| 1962 | 59 | 61 | 68 | 73 | 68 | 70 | 68 | 75 | 68 | 73 |
| 1963 | 59 | 61 | 68 | 72 | 68 | 72 | 68 | 72 | 64 | 70 |
| 1964 | 62 | 64 | 66 | 73 | 67 | 73 | 62 | 72 | 66 | 70 |
| 1965 | 58 | 61 | 67 | 72 | 68 | 75 | 68 | 72 | 66 | 71 |
| Year | Dissolved Oxygen (ppm) | | | | | | | | | |
| | Mean | Min. | Mean | Min. | Mean | Min. | Mean | Min. | Mean | Min. |
| 1953 | 9.5 | 8.8 | 8.7 | 8.4 | 7.6 | 7.4 | 6.3 | 6.0 | 2.0 | 0.7 |
| 1954 | 9.4 | 9.0 | 9.0 | 8.5 | 8.0 | 7.6 | 7.3 | 6.5 | 4.2 | 2.7 |
| 1955 | 9.2 | 9.2 | 9.0 | 9.0 | 7.6 | 7.4 | 6.7 | 5.9 | 4.1 | 2.2 |
| 1956 | 9.4 | 9.1 | 8.6 | 7.8 | 7.1 | 6.5 | 6.3 | 5.3 | 4.2 | 2.5 |
| 1957 | 9.5 | 8.8 | 8.6 | 8.0 | 7.1 | 6.0 | 5.3 | 3.5 | 2.4 | 1.2 |
| 1958 | 9.5 | 8.7 | 8.5 | 7.8 | 7.4 | 6.2 | 6.9 | 5.1 | 4.0 | 2.0 |
| 1959 | 10.4 | 9.4 | 9.2 | 8.0 | 7.7 | 7.0 | 6.6 | 3.9 | 4.3 | 2.2 |
| 1960 | 9.8 | 9.7 | 9.1 | 7.9 | 7.8 | 7.3 | 7.1 | 5.1 | 4.3 | 3.0 |
| 1961 | 9.3 | 8.6 | 9.3 | 7.7 | 7.6 | 6.9 | 6.9 | 4.3 | 3.7 | 1.8 |
| 1962 | 9.1 | 8.7 | 9.4 | 8.7 | 7.6 | 6.1 | 6.5 | 4.5 | 3.9 | 2.7 |
| 1963 | 9.4 | 9.1 | 9.2 | 8.4 | 7.7 | 6.8 | 5.6 | 3.4 | 3.6 | 2.0 |
| 1964 | 10.2 | 9.9 | 9.2 | 7.9 | 7.7 | 7.0 | 6.1 | 5.1 | 4.4 | 3.3 |
| 1965 | 8.9 | 8.7 | 8.8 | 8.3 | 7.7 | 7.1 | 6.4 | 4.3 | 3.9 | 3.0 |

1/ *From measurements made weekly by the Oregon State Sanitary Authority.*

Willamette Falls is on Willamette River at mile 26.6 near the town of Oregon City. Height of the falls, about 45 feet in the summer, is appreciably decreased in winter and spring from raises in tailwater levels caused by increased flow in the Willamette and Columbia Rivers. Slight tidal influence also extends upstream to the falls.

Willamette Falls formed a barrier to the upstream migration of salmon and steelhead even before man initiated changes there late in the nineteenth century. Although it was not a complete barrier previous to that time, the falls probably prevented runs of summer steelhead and fall chinook from being established.

## Species and Distribution

In 1965, 58,000 coho salmon and 26,000 winter steelhead trout escaped into the basin. This is about an average run. The average escapement of spring chinook, 1962 through 1964, was 36,500. Many of these, both salmon and steelhead, were hatchery fish. About 10,500 coho, 31,000 spring chinook, and 14,300 winter steelhead ascended the falls. The remainder entered Sandy and Clackamas Rivers and a few small tributaries below the falls. A small run of fall chinook now also ascend the falls and spawn in the Willamette. With the solution of the pollution problems of the lower river, and the passage problems at Willamette Falls, fall chinook could increase to become the most important run of fish in Willamette Basin.

Fairly large numbers of sea-run cutthroat trout enter Willamette River in late summer and fall. American shad, usually numbering in the thousands, spawn in May, June, and July between the river's mouth and Willamette Falls, and a few pass over the fishway. White sturgeon are common in the river, particularly below the falls.

Many resident cutthroat trout inhabit the entire river. When mature, these fish average 14 inches in length. They commonly leave the Willamette in winter and spring to spawn in tributary streams. Small populations of resident rainbow trout are centered primarily near Eugene. A few other salmonids are distributed throughout the stream in limited numbers.

During the summer warm water in the lower Willamette, especially in sloughs and oxbow lakes, provides favorable environment for warm-water game fish (Table II-6). Largemouth bass, bluegill, white crappie, black crappie, yellow perch, bullhead catfish, and warmouth bass are the predominant species. Channel catfish, stocked in recent years, are becoming established.

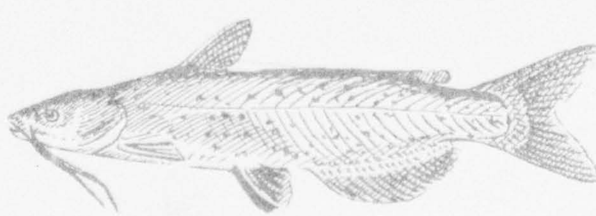


Table II-6

*Lakes influenced by Willamette River which provide angling for warm-water game fish 1/*

| Lake | County | Surface Acres | Public Access | Location |
|---|---|---|---|---|
| Ramsey | Multnomah | 150 | Yes | One mile south of the Columbia at confluence with Willamette River. |
| Oak Grove | Clackamas | 35 | Yes | In town of Oak Grove 2 miles south of Milwaukie. |
| Skookum | Marion | 20 | Charge | Three miles south of Newberg and west of State Highway 219. |
| Horseshoe | Marion | 35 | Charge | Two miles west of St. Paul. |
| Hubbard | Marion | 25 | No | Two miles east of Wheatland Ferry. |
| Deep | Marion | 10 | No | Three miles southeast of Wheatland Ferry. North of Waconda Road. |
| Mission | Marion | 40 | Charge | Just east of Wheatland Ferry. |
| Goose | Marion | 30 | No | Immediately south of Mission Lake. |
| Collard | Marion | 5 | No | East of Goose Lake, next to the Wheatland-Salem highway. |
| Finney & Egan | Marion | 5 | No | Three miles southeast of Wheatland Ferry and south of Waconda Road. |
| Clear | Marion | 35 | No | At village of Clear Lake, 7 miles north of Salem. |
| Willow | Marion | 15 | With Permission | One mile west of Keizer at north edge of Salem. |
| Hayden | Polk | 30 | No | Five miles north of Independence, between Highway 51 and Willamette River. |
| Humbug | Polk | 45 | No | Two miles north of Independence and south of Hayden Lake. |

Table II-6 (Cont'd)

| Lake | County | Surface Acres | Public Access | Location |
|---|---|---|---|---|
| Wilson | Linn | 10 | No | Five miles north of Albany and 0.5 mile east of Willamette River. |
| Fourth | Linn | 10 | No | East of Willamette River and 2.5 miles north of Albany. |
| Third | Linn | 10 | No | East of Willamette River and 2 miles north of Albany. |
| Second | Linn | 5 | No | East of Willamette River and one mile north of Albany. |
| First | Linn | 5 | No | East of Willamette River and on the north edge of Albany. |
| Thornton | Benton | 20 | No | One mile northwest of Albany. |
| Bryant | Linn | 10 | No | One mile west of Albany and one mile south of Willamette River. |
| Asbahr | Benton | 35 | No | At Children's Farm Home 2 miles northeast of Corvallis. |
| Stewart | Benton | 5 | No | At east edge of Corvallis and 0.8 mile north of Willamette River. |
| Colorado | Linn | 50 | Charge | Three miles east of Corvallis and one mile north of Corvallis-Lebanon road. |
| Porter | Benton | 15 | No | Four miles south of Corvallis and 0.5 mile east of Highway 99W. |
| McBee | Benton | 50 | No | Five miles south of Corvallis and 0.7 mile east of Highway 99W. |
| Whitaker | Benton | 19 | No | Six miles south of Corvallis and 0.7 mile east of Highway 99W. |
| Black | Benton | 15 | Yes | Seven miles south of Corvallis on south end of Smith Loop Road. |
| Miller | Benton | 20 | With Permission | One mile southwest of Black Lake, near Smith Loop Road. |
| Wagner | Benton | 15 | No | Just south of Miller Lake. |
| Oliver | Benton | 20 | No | Three miles north of Monroe and 0.5 mile east of Highway 99W. |

Table II-6 (Cont'd)

| Lake | County | Surface Acres | Public Access | Location |
|---|---|---|---|---|
| Garlinghouse | Benton | 15 | No | One and one-half miles north-east of Monroe. |
| Goodman | Lane | 15 | With Permission | Two miles south of Monroe and one mile east of Territorial Road. |
| Graham | Lane | 15 | With Permission | Two and one-half miles south of Monroe and one mile east of Territorial Road. |
| Hulbert | Lane | 20 | Yes | Three miles southwest of Monroe and one mile west of Highway 99W. |
| Goodpasture | Lane | 20 | Yes | Near Beltline Road on north edge of Eugene and 100 yards east of Willamette River. |

1/ *The most common game fish found in these lakes are white crappie, black crappie, bluegill, largemouth bass, warmouth, and brown bull-head*

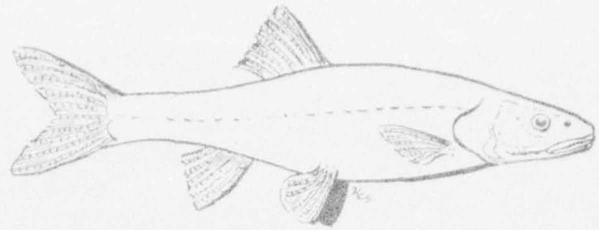
*Photo II-7. Seven crappie on a stringer. (R. J. Fischer photo)*

Large populations of nongame fish are found throughout the stream. Nongame species most detrimental to game fish are usually those occurring in highest numbers. Largescale suckers, carp, squawfish, chiselmouth, and redside shiners prey on and severely compete with game fish for food and living space.

## Developments and Conditions Adversely Affecting Fish Resources

Oregon's most critical pollution problems affecting fish production and angling are found in Willamette River. These problems are generally greatest in the lower river, especially during periods of reduced streamflow. Pollution of the Willamette limits aquatic life, especially game fish and the food organisms upon which they feed.

The most detrimental effect of pollution is the depression of the concentration of dissolved oxygen which fish must have for respiration. Toxic materials discharged into the river also impair fish production and cause mortalities. Chemical wastes have at times tainted salmon flesh, making it unpalatable. Slime growths and wood fibers commonly foul sport fishing gear, form sludge rafts, and decompose to release fetid gases.



Despite improvements being made in pollution abatement in Willamette River, an even higher degree of treatment will be required in the future to adequately treat pollutants that would otherwise be detrimental to aquatic life. Standards set by the State Sanitary Authority specify that dissolved oxygen content not be allowed to fall below 5 ppm downstream from Willamette Falls, 6 ppm from the falls to Newberg, and 7 ppm from Newberg to Salem. Upstream from Salem the standard is 90% of saturation. These concentrations are probably high enough to permit anadromous fish migration, but are considerably below the optimum. Low dissolved oxygen concentrations occur in the river for extensive periods each year (Table II-5), notably from June to October. In the summer of 1965, levels did not exceed five ppm for 110 consecutive days in Portland Harbor near river mile 8. Such low dissolved oxygen concentrations not only influence survival of fish, but also block or delay the entry of fall chinook salmon and other anadromous species into the river system. Relatively small delays in salmon spawning migration may reduce the reproductive capacity of the fish to the extent that they die without spawning.

Since many predatory species of fish have lower dissolved oxygen requirements than salmonids, and thrive in warmer waters, they are able to compete more successfully in Willamette River under present conditions than formerly. Large populations of predator fish are especially hazardous to downstream migrating juvenile salmon and steelhead. Successful introductions of fall chinook and summer steelhead in the Willamette drainage, and increases in the runs of anadromous fish, will largely depend upon improved pollution abatement.

Many juvenile salmon and steelhead are killed during their downstream migration through the power turbines at Willamette Falls. During low-water periods, a major portion of the flow is used to turn these turbines. The Oregon State Game Commission conducted studies in 1960 and 1961 to determine the mortality to fish passing through the major turbines. Mortality ranged from 7.7 to 100 percent in all turbines tested, but no estimate of the total mortality was possible.

Most of the turbines discharge into a bay-like area on the west bank of the river known as the "Cul-de-sac", a short distance below the falls (Figure II-1). Large numbers of adult anadromous fish are attracted into this blind alley by the large flows and are thus delayed in finding the ladder entrances. This and other upstream passage problems will be reduced on completion of the new fishway.

*Photo II-8. Dredging in Willamette River is necessary, but both fish and wildlife habitat may be destroyed. (Soil Conservation Service photo)*

Periodic gravel mining, bank revetment, and channel deepening have deleterious effects upon fish habitat. These activities cause increased water turbidity and bottom siltation and frequently remove valuable spawning gravel.

Access to fishing waters has become a problem. Not only is access to most lakes in the Willamette area restricted (Table II-6), but access to the river is difficult in many places.

Several unscreened diversions in tributaries are responsible for losses of anadromous fish. Diversions for consumptive use accentuate undesirable low-flow conditions.

Depressions in the flood plain along the river, particularly near Corvallis, trap fish following high water levels. A large natural depression below Willamette Falls, called the "Wet Hole", also frequently traps fish when water levels drop. This is to be capped with concrete during one of the later phases of Willamette Falls Fishway construction (Figure II-1).

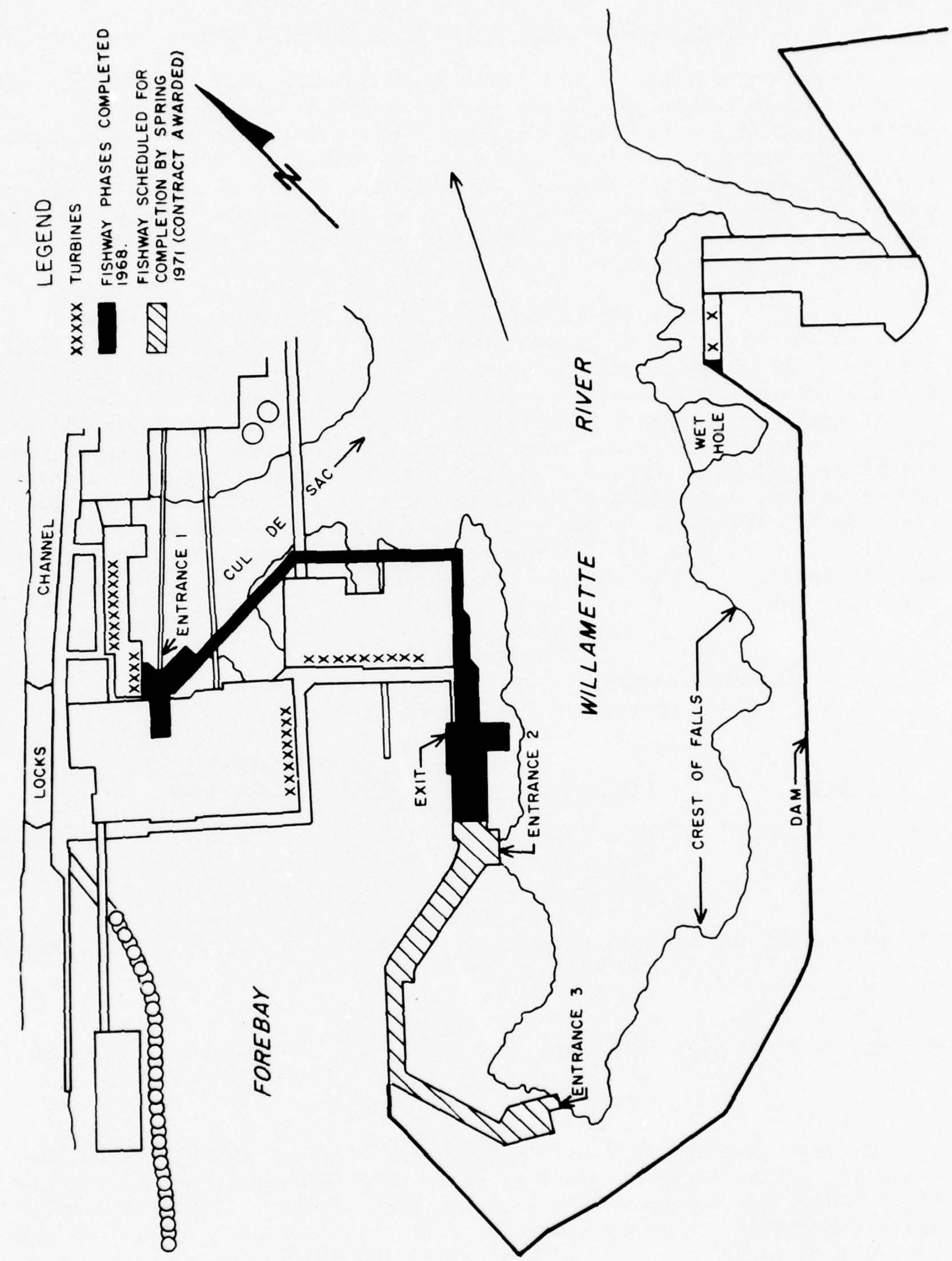



*Figure II-1. Sketch of Willamette Falls and vicinity showing locations of turbines and new fishway.*

Developments Beneficial to Fish Resources

Provision of fishway facilities at Willamette Falls began about 1885. A ladder located near the center of the falls was completed in 1904. Several alterations were made in the ladder, but it was never adequate. During periods of high river discharge, excessive water velocities in the ladder impeded fish passage. Conversely, in low flow periods most water was diverted around the falls for industrial uses, leaving inadequate flows passing over the falls to attract fish to the ladder entrances. Construction of a new fishway was started in 1966.

Table II-7 gives minimum stream flows set by the Oregon State Water Resources Board for three locations on Willamette River. In this and the similar table presented for each subbasin, the natural flows stipulated are subject to all water rights in force prior to June 22, 1964 in the Upper and Middle Willamette and May 25, 1966 in the Lower Willamette. In some cases also, these natural flow minimums are greater than the natural flows of record. The storage flows stipulated have usually been provided, and have assisted materially in diluting pollution, but the Corps of Engineers is not required, and in some cases may not be permitted, to furnish the flows when they are needed. The stipulations are, therefore, not guarantees that the indicated flows will be available for fish.

Table II-7
*Minimum streamflow stipulations established by the Oregon State Water Resources Board*

| Stream | Location | Minimum Flows (c.f.s.) Natural | Storage | Total |
|---|---|---|---|---|
| Willamette River | USGS Gage 14-1980 at Wilsonville | 1,500 | 4,700 | 6,200 |
| Willamette River | USGS Gage 14-1910 at Salem | 1,300 | 4,700 | 6,000 |
| Willamette River | USGS Gage 14-1740 at Albany | 1,750 | 3,140 | 4,890 |

Between 1965 and 1967 Portland General Electric Company installed aeration devices in seven draft tubes of their Willamette Falls facilities. Crown Zellerbach and Publisher's Paper Company installed similar devices in 1968. These have been effective in increasing dissolved oxygen by 1 to 1-1/2 parts per million below the facilities, but are used only during extremely low-water when dissolved oxygen conditions are critical.

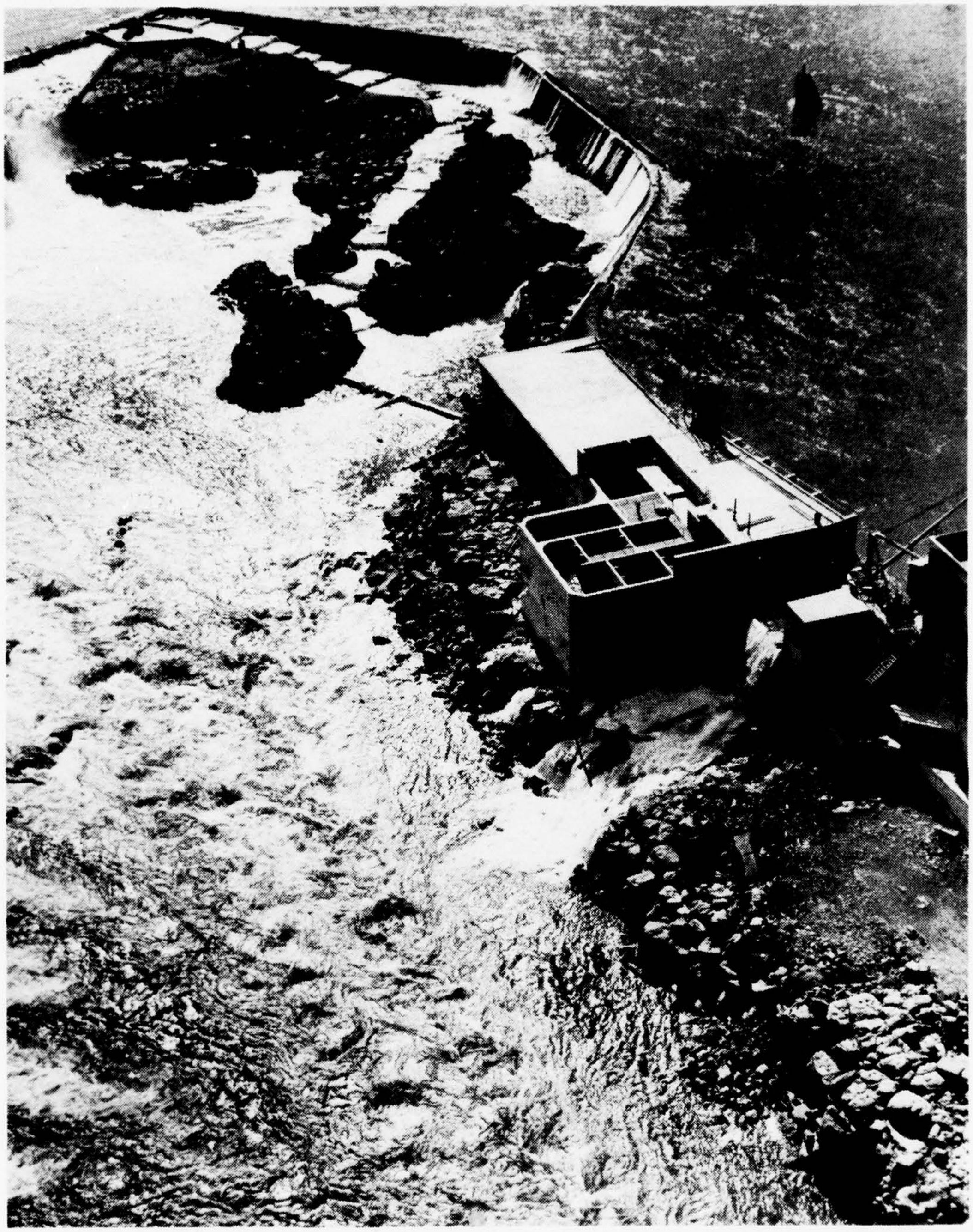


*Photo II-9. The Willamette Falls fish ladder, upper left, was constructed in 1904; construction on the improved fishway, center, was begun in 1966. (Ed Dull photo)*

Only limited stocking of trout and anadromous fish is made in the Willamette. Table II-8 gives fish release data for the 1961-1965 interval. Large plants of fall chinook were made in 1964 and 1965 with anticipation of increased pollution control and construction of Willamette Falls fishway. There is sporadic stocking of warm-water game fish in the area.

Table II-8

*Numbers of fish stocked in Willamette River 1961-1965*

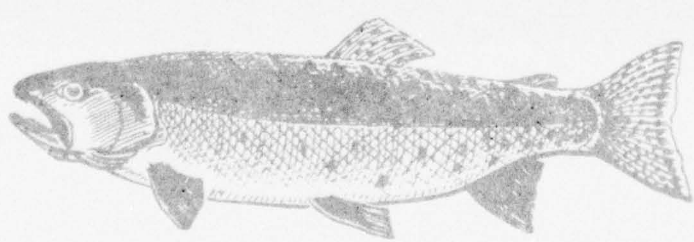
| Species | Mean Length (Inches) | Number per Pound | 1961 | 1962 | 1963 | 1964 | 1965 | Agency 1/ |
|---|---|---|---|---|---|---|---|---|
| Fall Chinook | - | 406 | | | | 1,836,000 | 2,588,000 | USFWS |
| " | - | 1,150 | | | | | 895,000 | FCO |
| Spring Chinook | - | 25-40 | | 2,600 | 4,000 | | | " |
| Rainbow | 8 & over | | | 2,500 | 3,000 | 5,000 | | OSGC |

1/ *Abbreviations used in this and subsequent tables are: "USFWS", U. S. Fish & Wildlife Service; "FCO", Fish Commission of Oregon; "OSGC", Oregon State Game Commission.*

## Present Economy

Since commercial fishing is prohibited in Willamette River and tributaries, and few anadromous fish spawn in the main river, the contribution to the Columbia River and Pacific Ocean commercial fisheries from this reach is largely one of providing transportation for migrating fish. The contribution will increase dramatically when fall chinook become established in the river.

Spring chinook salmon receive the heaviest sport angling pressure exerted on anadromous fish. This fishery takes place almost entirely below Willamette Falls, extending from a deadline below the falls to the river's mouth and throughout Multnomah Channel. It is Oregon's largest inland salmon fishery exclusive of the Columbia River.



Most of the angling for spring chinook is conducted from boats in the months of March, April, and May during the period of upstream migration. Some bank fishing occurs at the mouth of Clackamas River, and at Black Point near Willamette Falls. Estimation of the catch was initiated in 1941 and continued in 1942 by the U. S. Fish and Wildlife Service and was resumed in 1946 as a joint study by the Oregon State Game Commission and Fish Commission of Oregon. Basic angler effort and catch data are obtained from airplane counts of boats and from catch records of cooperating moorage operators. For the 20-year period beginning in 1946, anglers have harvested an average 11,939 spring chinook in 91,760 angler-days valued at $551,000 annually.

Most angling for coho salmon and steelhead trout takes place just below Willamette Falls and at the mouth of Clackamas River. Both boat and bank fishing are popular. Fishing pressure, as compared with the spring chinook fishery, is moderate. Angling for coho occurs mainly in November and December and for steelhead from December until the spring chinook fishery begins. Fishermen catch approximately 7,900 coho and 900 steelhead in 12,100 fisherman days valued at $73,000 annually.

There is moderate to heavy fishing pressure on shad just below Willamette Falls in May, June, and July. Angling for sturgeon is light to moderate throughout the river during much of the year. Heaviest pressure occurs in the spring in the vicinity of Oregon City. Sport fisheries for both sturgeon and shad are gaining in popularity. The 1965 harvest was calculated to be 13,300 shad and 7,600 sturgeon. A calculated 39,000 angler days, valued at $117,000, were expended on these fisheries. The expenditure of time in 1965 is believed to approximate the time expended during an average year.

Warm-water game fish receive more angler pressure than other fish, with the exception of spring chinook salmon. Largemouth bass, bullhead catfish, bluegill, and crappie make up the bulk of the catch. Fishing effort is directed more upon slough areas and adjacent oxbow lakes than upon the main river channel. Although permitted year around, the fishery receives most attention in spring and summer. In 1965 this fishery produced an estimated 48,500 fish in 26,600 angler days valued at $40,000.

Light to moderate fishing for resident cutthroat is conducted in all portions of the river during trout season. This fishery is commonly overlooked and somewhat limited because of generally low angler success rates and competition from more popular areas. Approximately 17,000 trout are caught in an estimated 9,800 angler-days, valued at $29,000 annually.

## SUBBASIN 1 - COAST FORK

### Habitat

Coast Fork Willamette River, 51 miles long and draining 665 square miles, flows from the north slope of the Calapooya Mountains and joins Middle Fork Willamette River near Eugene to form Willamette River. Row River, which drains nearly 60 percent of the subbasin, enters from the east at river mile 20.7 (Map II-1).

All streams of the Coast Fork Willamette River system, including Row River, have important fish populations. Cottage Grove Reservoir on the Coast Fork and Dorena Reservoir on Row River support important managed sport fisheries. Crawfish Lake, 2 acres in area, is the only high mountain lake in the subbasin.

Spawning gravel is scarce in many subbasin streams, but limits production of salmonids in only a few of the smaller tributaries. Stream discharges are relatively low in summer but higher than those in most tributaries entering Willamette River from the west.

Cottage Grove Reservoir, a 1,160-acre impoundment, is located on the Coast Fork at river mile 29.7. Another reservoir, Dorena, at river mile 7.6 on Row River contains 1,840 surface acres. Neither dam is laddered, so many miles of stream habitat are closed to anadromous fish.

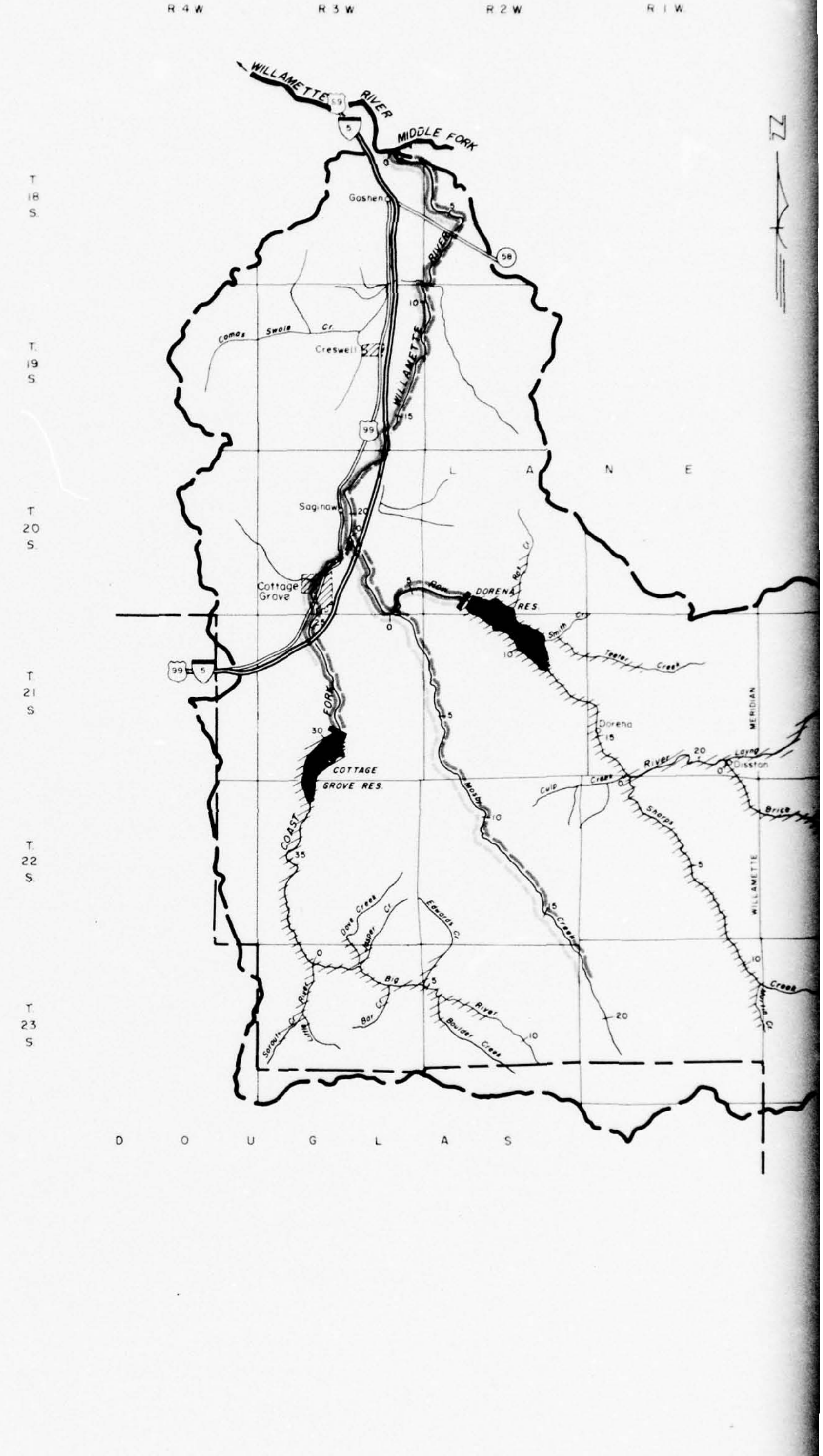
Minimum summer flows of 50 and 100 cubic feet per second are usually released from Cottage Grove and Dorena Reservoirs respectively. Water temperatures seldom exceed 70°F in streams above the two reservoirs. These temperatures are adequate for cutthroat and rainbow trout. Water temperatures in the rivers and their tributaries below the impoundments commonly reach 80°F, which is unfavorable for cold-water species such as trout. Temperatures in Dorena and Cottage Grove Reservoirs favor production of warm-water game fish and nongame fish. The reservoirs support rainbow and cutthroat trout, but numbers are limited by the warm water and by competition from fish better suited to the environment.

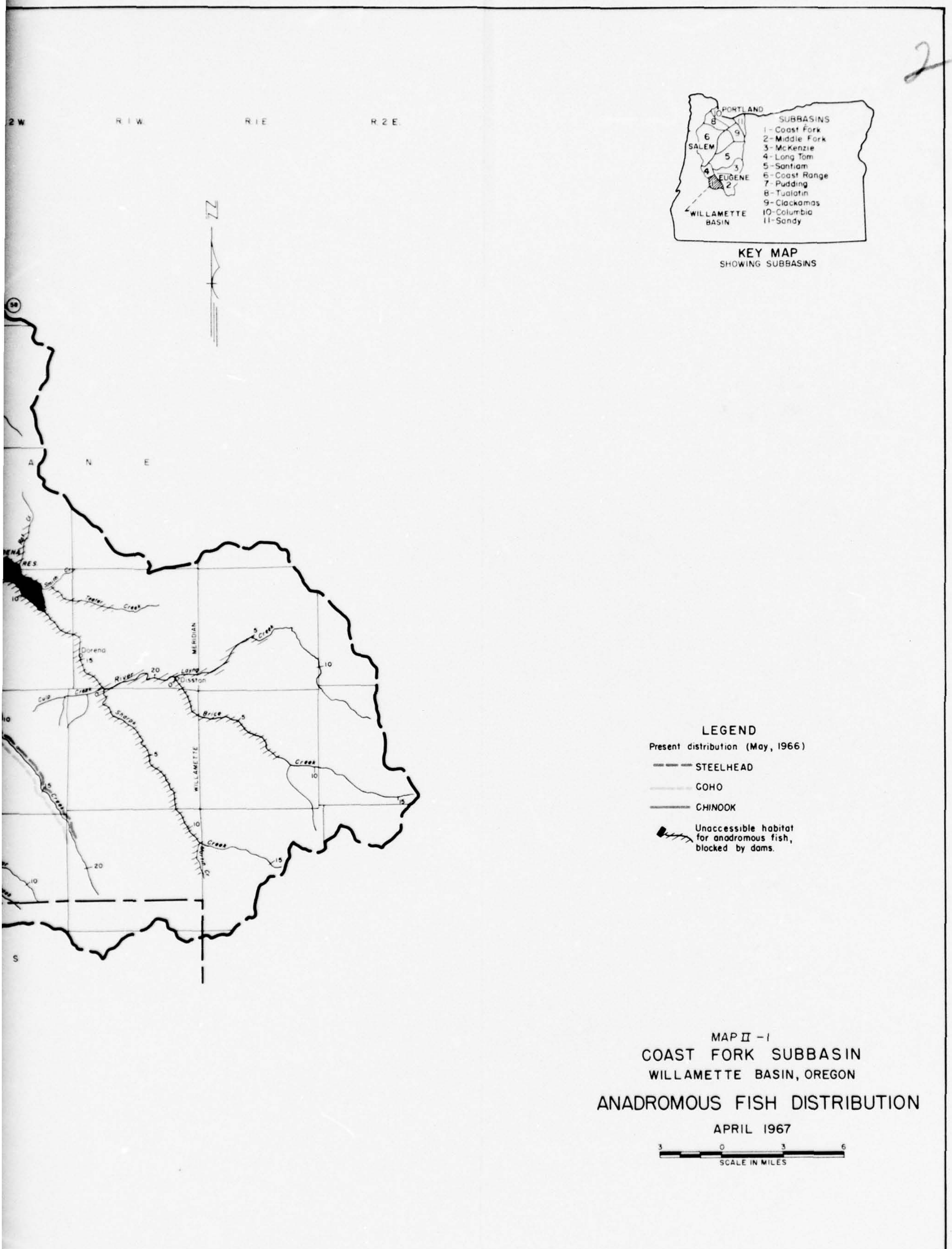
### Species and Distribution

Before construction of Dorena and Cottage Grove Dams, some spring chinook, and possibly winter steelhead, entered the Coast Fork and Row River. In recent years, small sporadic runs of both species have been recorded in lower portions of the two rivers. Coho salmon have been planted since 1963 in the Row River system, but success of the introductions has not been determined.

Resident cutthroat and rainbow trout are common in streams of the upper drainage. Most of the trout in Dorena Reservoir are planted rainbow, but cutthroat predominate in Cottage Grove Reservoir. Cutthroat numbers are moderate and native rainbow occur frequently in the rivers below the reservoirs. Rainbow were stocked in Crawfish Lake in 1964.

Prepared by
WILLAMETTE BASIN TASK FORCE
of the
PACIFIC NORTHWEST RIVER BASINS COMMISSION






MAP II-1
COAST FORK SUBBASIN
WILLAMETTE BASIN, OREGON
ANADROMOUS FISH DISTRIBUTION
APRIL 1967

WBTF 1-1163d-LL

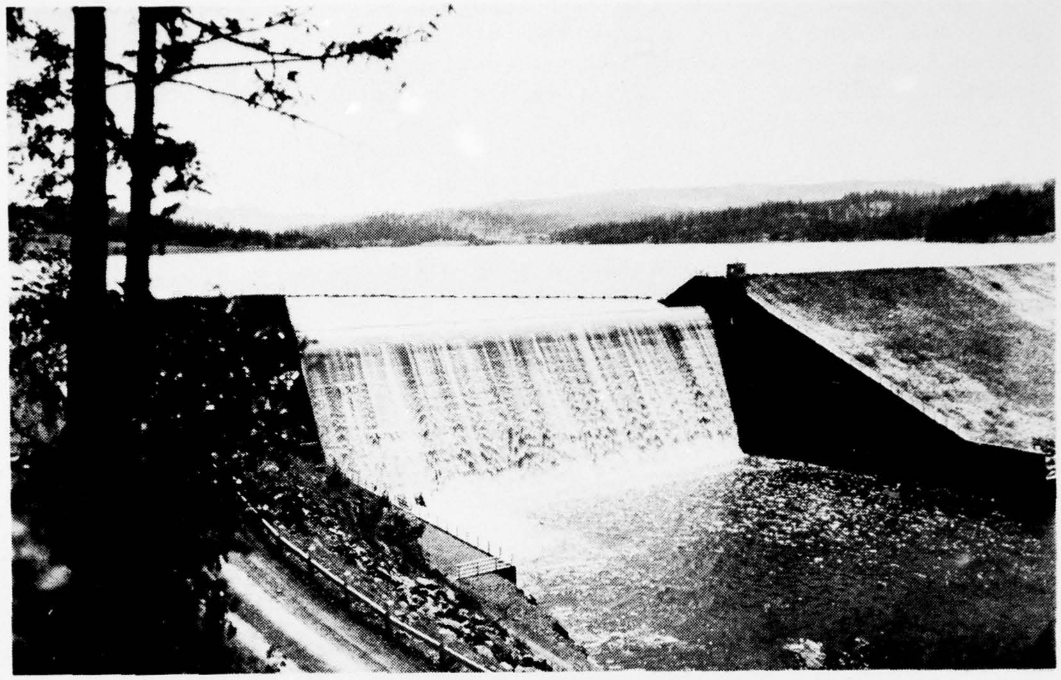


*Photo II-10. Cottage Grove Dam and Reservoir on the Coast Fork Willamette River. (Corps of Engineers photo)*

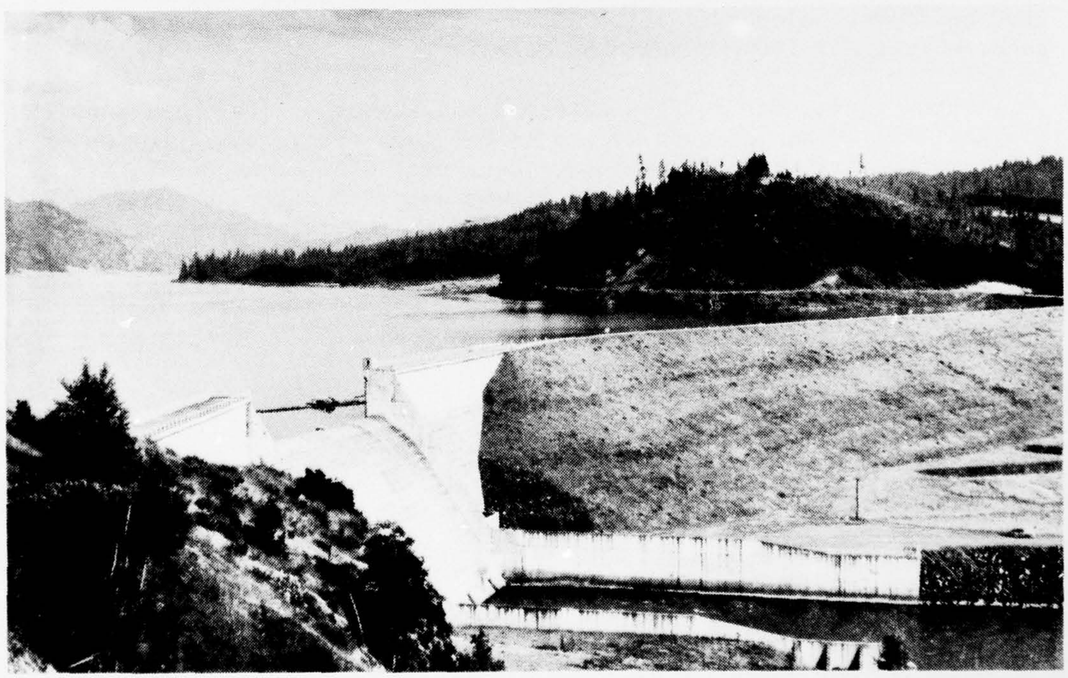


*Photo II-11. Dorena Dam and Reservoir on Row River. (Corps of Engineers photo)*

Warm-water game fish maintain substantial populations in Cottage Grove and Dorena Reservoirs. Largemouth bass and bullhead catfish are the most abundant species. Several species of warm-water game fish, including smallmouth bass, exist in low to moderate numbers downstream from the two impoundments.

Largescale suckers, squawfish, redside shiners, and other nongame fish thrive in the rivers below the reservoirs. A few of these species, notably the largescale sucker, were common in Cottage Grove Reservoir and lower parts of its tributary system and prompted a rehabilitation project there in 1966. Subsequently, rainbow and cutthroat trout and largemouth bass were stocked in the reservoir and smallmouth bass were introduced in the Coast Fork above the reservoir.

Developments and Conditions Adversely Affecting Fish Resources

Cottage Grove Dam, 95 feet high, was completed in 1942 on the Coast Fork at river mile 29.7. Dorena Dam, 145 feet high, was completed at river mile 7.6 on Row River in 1949. Neither dam is provided with fish passage facilities. Both dams, constructed by the Corps of Engineers, are operated for flood control and to store water for irrigation and navigation.

Cottage Grove and Dorena Dams prevent anadromous fish access to the subbasin's better spawning and rearing streams. Approximately half of the 160 stream miles of habitat for these species is located above the two impoundments. The release of warm water from the reservoirs appreciably reduces the value of the lower Coast Fork and Row River for salmonid production. Also, the amount of water released in the fall is often inadequate for salmon migration and spawning. The impoundments provide good habitat for large numbers of nongame fish.

Water rights for surface water in the subbasin total more than 150 cfs (Table II-9). Most of this volume is for consumptive use. The major points of diversion for consumptive use, excluding Layng Creek, are downstream from Cottage Grove and Dorena Dams. During the summer, reservoir releases compensate for much of the consumptive water use and also provide significant flows in the lower river. The City of Cottage Grove obtains its municipal water from Layng Creek, a principal tributary of upper Row River, thereby further reducing naturally low summer flows.

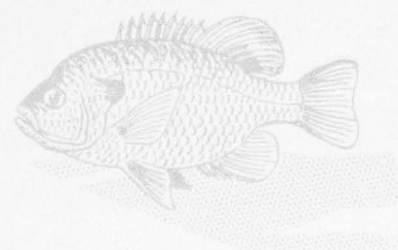


Table II-9

*Appropriated surface water and minimum streamflow measurement data, Coast Fork Subbasin (cfs)*

| Stream Area | Appropriated Surface Water 1/ | | Instantaneous Minimum Flows Measured | | | |
|---|---|---|---|---|---|---|
| | Non-Consumptive | Consumptive | Instantaneous Discharge | Location | Date 2/ | Source 2/ |
| Coast Fork Willamette River downstream from Cottage Grove Dam | 0.03 | 70 | "Practically no flow" | 0.3 mile downstream from Cottage Grove Dam | July 1945 & August 1947 (1939-1967) | USGS |
| Tributaries to Coast Fork downstream from Cottage Grove Dam | 0.7 | 26 | - | - | - | - |
| Coast Fork Willamette River upstream from Cottage Grove Dam | 0.0 | 13 | 10 | River mile 35.9 | Several days in 1936 (1935-1965) | USGS |
| Tributaries to Coast Fork upstream from Cottage Grove Dam | 0.0 | 1.5 | - | - | - | - |
| Row River downstream from Dorena Dam | 0.0 | 5.5 | 0.2 | 2.1 miles downstream from Dorena Dam | Sept. 25, - Oct. 7, 1958 (1939-1967) | USGS |
| Mosby Creek System | 0.0 | 5.5 | 3.0 | At mouth | Sept. 4, 1967 (1946-1967) | USGS |
| Other tributaries to Row River downstream from Dorena Dam | 0.0 | 0.0 | 3.9 | Mile 1.0 | - | - |
| Row River upstream from Dorena Dam | 9.3 | 12 | 10 | River mile 13.2 | Sept. 24, 25, 1951 Oct. 7, 8, 1958 (1935-1965) | USGS |
| Brice Cr. System | 0.0 | 0.3 | 9.3 | Mile 1.0 | Oct. 12, 1964 | OSGC |
| Layng Cr. System | 0.0 | 14 | 5.3 | Mouth | Oct. 12, 1964 | OSGC |
| Sharps Cr. System | 4.9 | 1.1 | 5.6 | Mouth | Aug. 25, 1964 | OSGC |
| Other tributaries to Row River upstream from Dorena Dam | 0.0 | 0.0 | - | - | - | - |

1/ *Oregon State Water Resources Board records, April 1966.*

2/ *U. S. Geological Survey periods of available records are shown in parenthesis. Oregon State Game Commission listings are the lowest of flows measured monthly in low discharge periods of 1964 and 1965.*

An unladdered dam, 4 feet high, on the Coast Fork near river mile 23.0 blocks the upstream migration of fish during low flows. Another 4-foot dam, which has an inadequate ladder for anadromous fish, is located on the Coast Fork at river mile 25.3 immediately downstream from Interstate Highway 5. Two dams on Layng Creek limit intrastream migration by trout.

Fish production is impaired by low dissolved oxygen concentrations resulting from log pond wastes that occasionally enter the Coast Fork about one-half mile below Martin Creek, and Row River near the mouth of Culp Creek. Improper logging activities that contribute to stream siltation and debris jams still occur in the upper watershed but are not as prevalent as they once were. Periodic gravel mining along lower Row River and Coast Fork causes high water turbidity and thick deposits of silt on the streambed. Waters of Cottage Grove Reservoir are frequently turbid because of wave action. At such times the river downstream is also discolored.

There is significant habitat for salmon and steelhead production above 15-foot Wildwood Falls at mile 18.5 on Row River. Potential habitat above falls in upper portions of several other streams is small and probably not sufficient to justify fish-passage improvements.

The basin contains meager quantities of spawning gravel, and much of the rearing area is of limited value to anadromous fish because of low summer flows, high summer and fall water temperatures, and low water quality. Conversely, conditions favor nongame fish which compete directly with more valuable species.

## Developments Beneficial to Fish Resources

Cottage Grove and Dorena Reservoirs create habitat favorable for warm-water game fish. Increases in number of nongame fish, and the drawdown of the reservoirs in summer and fall, lessen the quality of this habitat.

The number of fish liberated into streams of the subbasin in the 1961-1965 interval are listed in Table II-10. Winter steelhead and spring chinook were stocked between 1950 and 1960 but returns have been small.

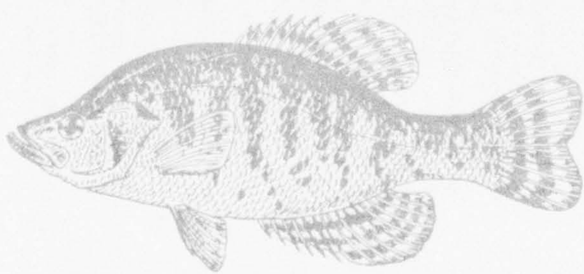


Table II-10

*Numbers of fish stocked in Coast Fork Willamette Subbasin, 1961-1965*

| Stream System or Reservoir | Species | Mean Length (Inches) | Number per pound | 1961 | 1962 | 1963 | 1964 | 1965 | Agency |
|---|---|---|---|---|---|---|---|---|---|
| Coast Fork Willamette River | Rainbow | 8 & over | - | 8,000 | 8,000 | 8,100 | 8,000 | 4,000 | OSGC |
| Row River System | Coho | - | 1100-1168 | | | 300,000 | | 511,300 | FCO |
| Row River System | Rainbow | 8 & over | - | 36,700 | 38,100 | 38,600 | 38,000 | 30,000 | OSGC |
| Dorena Reservoir | Rainbow | 2-4 | - | | | 100,100 | 90,000 | 151,000 | " |
| Dorena Reservoir | Rainbow | 4-6 | - | | | | | 50,400 | " |
| Dorena Reservoir | Rainbow | 8 & over | - | 8,400 | 28,000 | 25,000 | 26,800 | 28,200 | " |
| Cottage Grove Res. | Rainbow | 8 & over | - | 3,800 | 5,000 | 4,700 | 5,000 | | " |

Because of large populations of nongame fish, occasional chemical treatment of Cottage Grove and Dorena Reservoirs has been necessary. The impoundments are then restocked with game species.

Table II-11 lists minimum streamflow stipulations established for the subbasin by Oregon State Water Resources Board. Future appropriations may be made only for domestic or livestock uses from natural flows of the listed stream areas.

Oregon State Game Commission has developed recommendations for minimum streamflows throughout the subbasin. These figures are tabulated in Table II-12.

This subbasin contains 14 private stocked fish ponds. Most of these are not open to the public except on a fee fishing basis.

## Present Economy

The contribution of anadromous fish from the subbasin to commercial and sport fisheries is negligible. In spring and summer, heavy pressure is exerted on wild rainbow and cutthroat trout and hatchery rainbow trout in streams above the two reservoirs. Hatchery rainbow provide most of the trout catch from the rivers below the dams. The stream fishery contributed an estimated 1,800 angler-days valued at $5,000 in 1965. This is believed to approximate the pressure during an average year.

Fishing in Dorena and Cottage Grove Reservoirs is permitted all year. Of the two reservoirs, Dorena receives the most fisherman use and therefore receives larger plants of fish. Most trout fishing at these impoundments occurs between the months of October and June. The reservoirs provided an estimated 37,600 trout fisherman-days valued at $75,000 in 1965. This approximates an average year.

Table II-11
*Minimum streamflow stipulations established by the Oregon State Water Resources Board*

| Stream | Location | Minimum Flows (cfs) 1/ Natural | Storage | Total |
|---|---|---|---|---|
| Coast Fork Willamette R. & tributaries | Upstream from mouth | 40 | 250 | 290 |
| Coast Fork Willamette R. & tributaries | Upstream from confluence with Row R. | 15 | 100 | 115 |
| Row River & tributaries | Upstream from mouth | 40 | 150 | 190 |

1/ *"Natural" minimum flow stipulations were set by the Oregon State Water Resources Board. The "storage" volumes are provided in addition whenever possible from U. S. Army Corps of Engineers dams operated to provide increased low-water flows for navigation.*

Table II-12

*Minimum flows for fish life recommended to Oregon State Water Resources Board by Oregon State Game Commission 1/*

| Stream | Location | Dec-May | June | July | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|
| Coast Fk. Willamette R. | USGS Gage 14-1525 | 100 | 40 30 | 20 15 | 10 | 10 | 10 | 10 100 |
| Coast Fk. Willamette R. | USGS Gage 14-1535 2/ | 125 | 70 50 | 50 | 50 | 50 | 50 | 75 125 |
| Coast Fk. Willamette R. | USGS Gage 14-1575 2/ | 200 | 150 | 150 | 150 | 150 | 150 | 150 200 |
| Big River | Mouth | 45 | 25 15 | 10 8 | 6 | 6 | 6 | 25 45 |
| Garouti Creek | Just upstream from Big R. | 25 | 12 10 | 8 6 | 4 | 4 | 4 | 20 25 |
| Wilson Creek | Mouth | 10 | 3 2 | 2 1 | 1 | 1 | 1 | 5 10 |
| Row River | USGS Gage 14-1545 | 150 | 100 60 | 40 25 | 20 | 20 | 20 | 90 150 |
| " " | USGS Gage 14-1555 2/ | 175 | 125 100 | 100 | 100 | 100 | 100 | 100 175 |
| Brice Creek | Mouth | 75 | 60 50 | 25 15 | 8 | 8 | 8 | 50 75 |
| Champion Cr. | " | 15 | 12 8 | 6 3 | 1 | 1 | 1 | 10 15 |
| Layng Creek | " | 65 | 50 40 | 20 12 | 5 | 5 | 5 | 40 65 |
| Mosby Creek | USGS Gage 14-1565 2/ | 90 | 40 25 | 15 10 | 10 | 10 | 10 | 75 90 |
| Rat Creek | Mouth | 12 | 3 | 2 1 | 0.5 | 0.5 | 0.5 | 10 12 |
| Sharps Creek | " | 70 | 50 30 | 15 10 | 5 | 5 | 5 | 50 70 |
| " " | Just upstream from Martin Creek | 20 | 10 8 | 3 2 | 1 | 1 | 1 | 15 20 |
| Martin Creek | Mouth | 20 | 10 8 | 3 2 | 1 | 1 | 1 | 15 20 |
| Smith Creek | Just upstream from Teeter Creek | 15 | 3 | 2 2 | 2 | 2 | 2 | 10 15 |
| Teeter Creek | Just upstream from Smith Creek | 20 | 8 | 6 4 | 2 | 2 | 2 | 12 20 |

1/ *Where 2 figures are shown, minimums change during the month.*
2/ *From listed gage to mouth of listed stream.*

## SUBBASIN 2 - MIDDLE FORK

This subbasin includes the Middle Fork Willamette River and its tributaries - Map II-2. Within it, approximately 110 lakes in the Cascade Range provide important habitat for trout. Fall Creek, Hills Creek, Lookout Point, and Dexter Dams have created additional nonstream environment.

### Habitat

The Middle Fork originates at Timpanogas Lake near the summit of the Cascade Range and flows northwesterly for 83.5 miles to join the Coast Fork near Eugene and form Willamette River. The watershed covers 1,354 square miles. North Fork, a major tributary, flows from Waldo Lake for 43.5 miles to enter the Middle Fork at river mile 37.5. Other major tributaries are Fall Creek, Salmon Creek, and Salt Creek. Most of the subbasin is mountainous with 75 percent of the area above 2,000 feet elevation (Map 11-2)

Average annual discharge of the Middle Fork is about 4,000 cfs. Discharge is regulated by four U. S. Army Corps of Engineers dams and seldom drops below 1,000 cfs at the mouth.

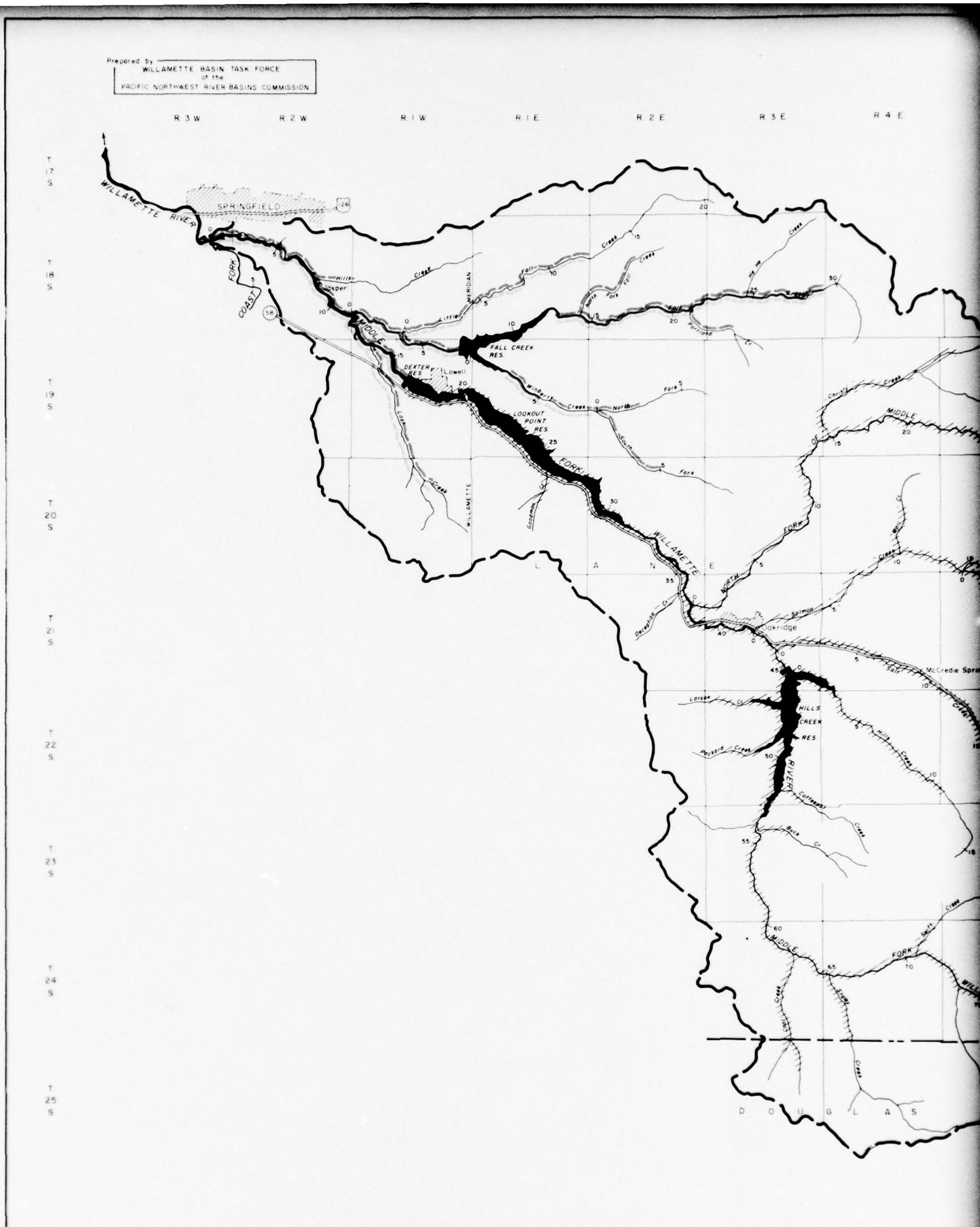
Streamflow quantity and quality are generally favorable for salmonids except in uncontrolled tributaries entering the river below Lookout Point Reservoir. In the lower reaches of these tributaries, summer water temperatures commonly range between 65° and 75° F, which limits production of salmonids. Streams in the watershed upstream from Lookout Point Reservoir are cool with water temperature rarely exceeding 65° F.

The dams on the Middle Fork are Dexter at river mile 16.8, Lookout Point at river mile 19.9, and Hills Creek at river mile 45.5. Respective reservoir areas are 1,025, 4,360, and 2,735 surface acres. None of these has fish passage facilities. A fourth Corps of Engineers dam, with fish passage facilities, is located at river mile 7.2 on Fall Creek, forming a reservoir of 1,880 surface acres. There is good habitat for salmonids in all the above impoundments, but large numbers of nongame fish preclude the production of trout and salmon in Dexter and Lookout Point Reservoirs.

Water conditions favor salmonid production in the Cascade Lakes. The largest, Waldo Lake, covers 5,500 acres and supports substantial populations of rainbow and brook trout.

### Species and Distribution

In 1965, more than 400 winter steelhead and 6,100 spring chinook entered Middle Fork Willamette River. This is believed to have approximated the average run before Willamette Falls fishway and Fall Creek Reservoir had been placed in operation. About 60 percent of the winter steelhead, but less than 2 percent of spring chinook, entered Fall Creek.



Prepared by
WILLAMETTE BASIN TASK FORCE
of the
PACIFIC NORTHWEST RIVER BASINS COMMISSION
R 3 W.
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T 17 S
T 18 S
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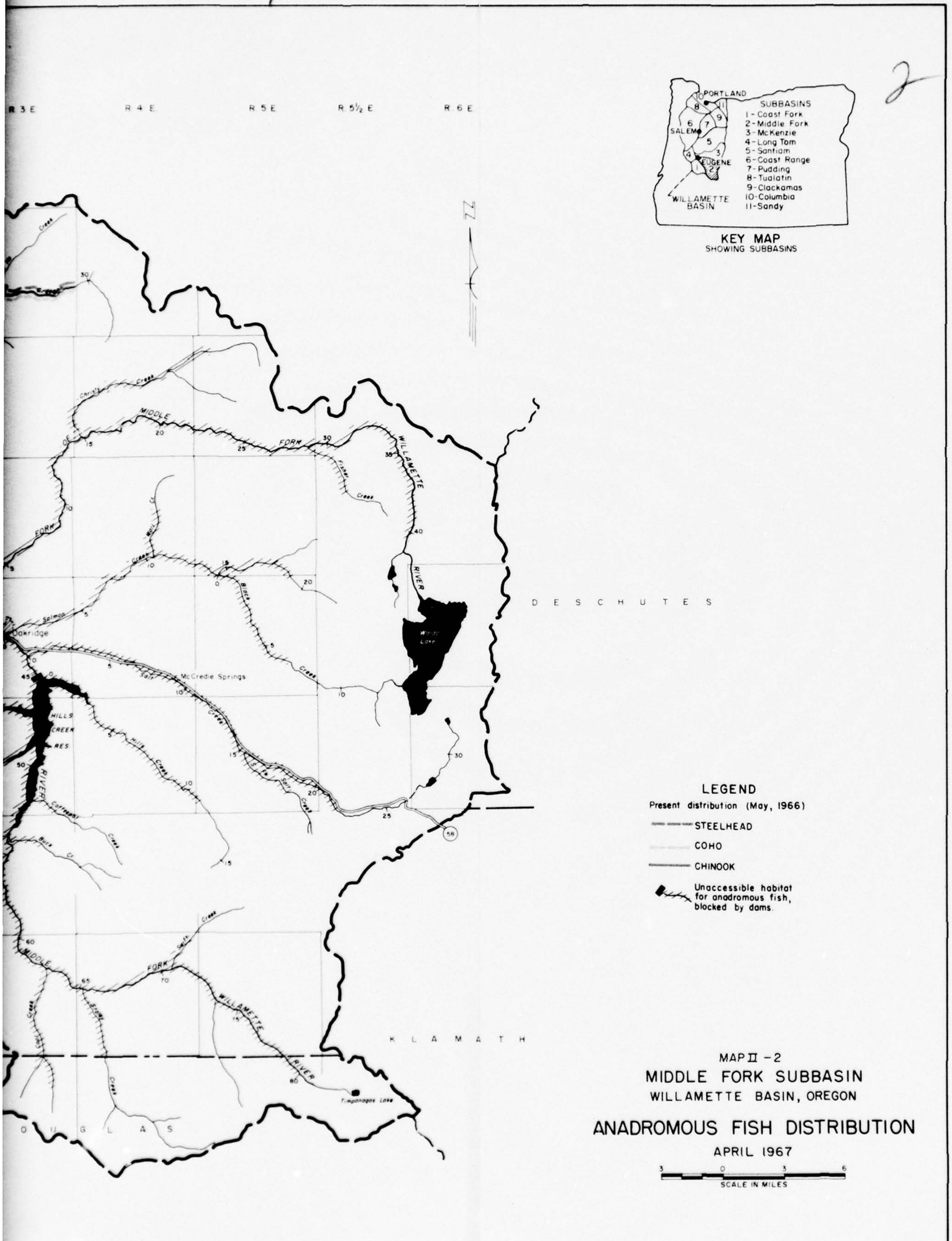
T 20 S
T 21 S
T 22 S
T 23 S
T 24 S
T 25 S
WILLAMETTE RIVER
SPRINGFIELD
Jasper
COAST FORK
FALL CREEK RES.
DEXTER RES.
Lowell
LOOKOUT POINT RES.
MIDDLE FORK WILLAMETTE
NORTH FORK
Oakridge
HILLS CREEK RES.
L A N E
D O U G L A S




MAP II -2
MIDDLE FORK SUBBASIN
WILLAMETTE BASIN, OREGON

ANADROMOUS FISH DISTRIBUTION

APRIL 1967

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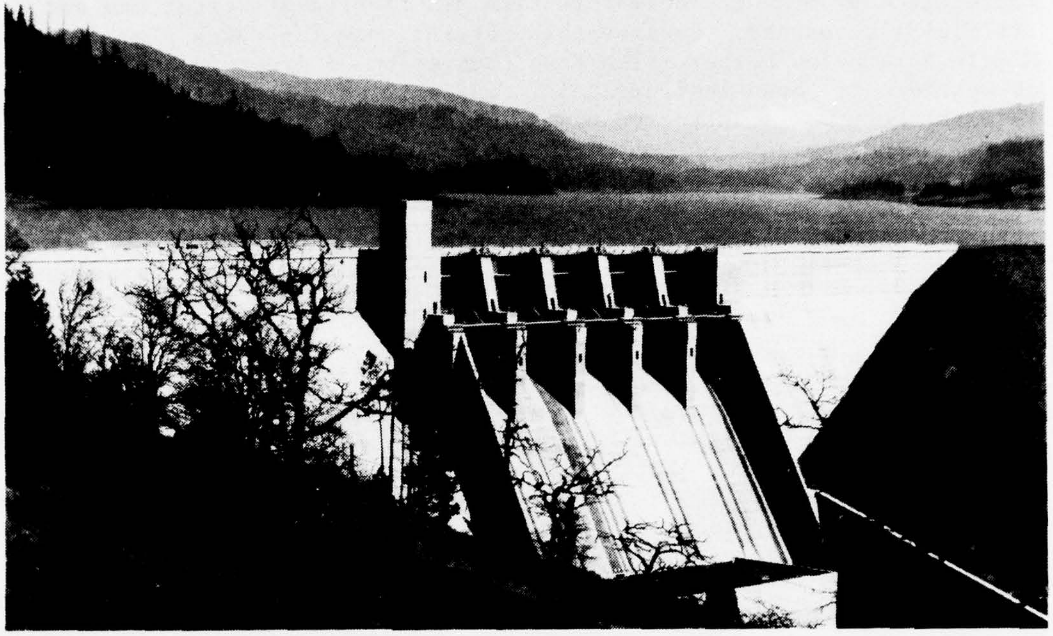


*Photo II-12. Lookout Point Dam on Middle Fork Willamette River. (Corps of Engineers photo)*

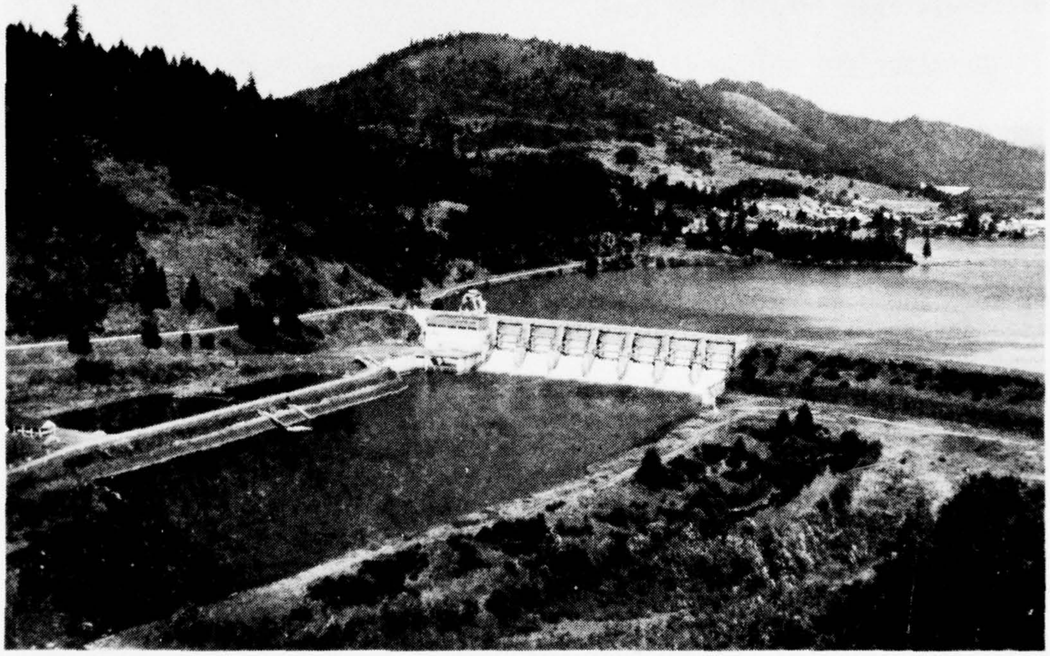


*Photo II-13. Dexter Dam on Middle Fork Willamette River. (Corps of Engineers photo)*

The subbasin upstream from Dexter Dam is closed to anadromous fish, therefore many of the Middle Fork fish are trapped at Dexter Dam and artificially spawned. Considerable natural spawning takes place in the Middle Fork below Dexter. The Fish Commission of Oregon's hatchery at Oakridge has been instrumental in maintaining spring chinook runs. This hatchery was constructed by the Corps of Engineers as mitigation for fish lost because of Lookout Point and Dexter Dams. Fall chinook, coho, and sockeye salmon have been stocked in the lower Middle Fork since 1953, but no significant runs have yet been established. Establishing runs of these and other anadromous species that enter Willamette River in summer and fall depends largely upon reduction of pollution in the lower river.

Resident cutthroat and rainbow trout occur throughout the drainage. Cutthroat numbers are moderate to high in most streams. The rainbow populations are low to moderate and confined more to low-elevation areas. Hatchery rainbow are stocked in all larger streams and in Fall Creek and Hills Creek Reservoirs. Whitefish are common in larger streams which also support a few Dolly Varden. The lakes in the Cascade Range receive periodic plants of rainbow and brook trout. Kokanee have been liberated into Waldo Lake in recent years and have become established.

Nongame fish common in the Middle Fork drainage are largescale suckers, squawfish, redside shiners, and chiselmouth. These four species, particularly suckers and squawfish, are numerous in Dexter and Lookout Point Reservoirs and the lower portions of their tributary systems. Low numbers of warm-water game fish extend upstream from Willamette River a short distance into Middle Fork.

Developments and Conditions Adversely Affecting Fish Resources

Dams have adversely affected game fish and their harvest. More than 215 miles of stream environment, 80 percent of the subbasin's total, is closed to salmon and steelhead by Dexter Dam. Lookout Point, Hills Creek, and Hines Lumber Company Dams, upstream from Dexter, are also impassable. Excellent runs of spring chinook once utilized the upper Middle Fork and its tributaries, North Fork, Salmon Creek, and Salt Creek. The magnitude of these runs was comparable to, and possibly exceeded, runs of nearby McKenzie River.

Hatchery facilities provided by the Corps of Engineers as mitigation for losses from construction of dams are not capable of rearing the number of juvenile salmon and steelhead that could be produced in the streams isolated by the barriers. Adult spring chinook are now forced to remain in the lower river, or in a holding pond at the Dexter Dam fish trap, during summer and fall prior to spawning. Before construction of the dams, salmon ascended to cooler, higher elevation streams to mature. Spring chinook compelled to remain below Dexter Dam occasionally suffer severe losses from disease associated with warm water temperatures. Losses have been relatively light since 1961, however, possibly because of cool water released from Hills Creek Reservoir.

Quantities of water released into the river from Dexter Reservoir are normally adequate for fish life. However, releases are sometimes quickly and drastically reduced for flood control purposes. These reductions strand many fish in side channels and pools, resulting in heavy mortality. If the river level were lowered more slowly, fewer fish would be killed.

Nongame species have found havens in the warm pools formed by Dexter and Lookout Point Dams. Many have spread upstream from Lookout Point Reservoir to streams where they previously were uncommon or nonexistent. Following construction of the two dams, trout stocked in the impoundments thrived for a few years until competition from suckers, squawfish, and other nongame species became intense. Angler effort and catch dropped from 25,000 angler-days and 45,200 trout at Lookout Point in 1955 to a relatively few angler-days and 1,500 trout in 1959. The pattern at Dexter was quite similar with 19,200 angler-days to catch 26,900 trout in 1956, while only a handful of anglers took fewer than 2,000 fish three seasons later. Trout are no longer planted in either reservoir because of the large populations of competing nongame fish.

Hills Creek, Lookout Point, and Dexter Reservoirs inundate 31.8 miles of stream habitat that formerly produced salmon and trout, and where anglers came to fish.

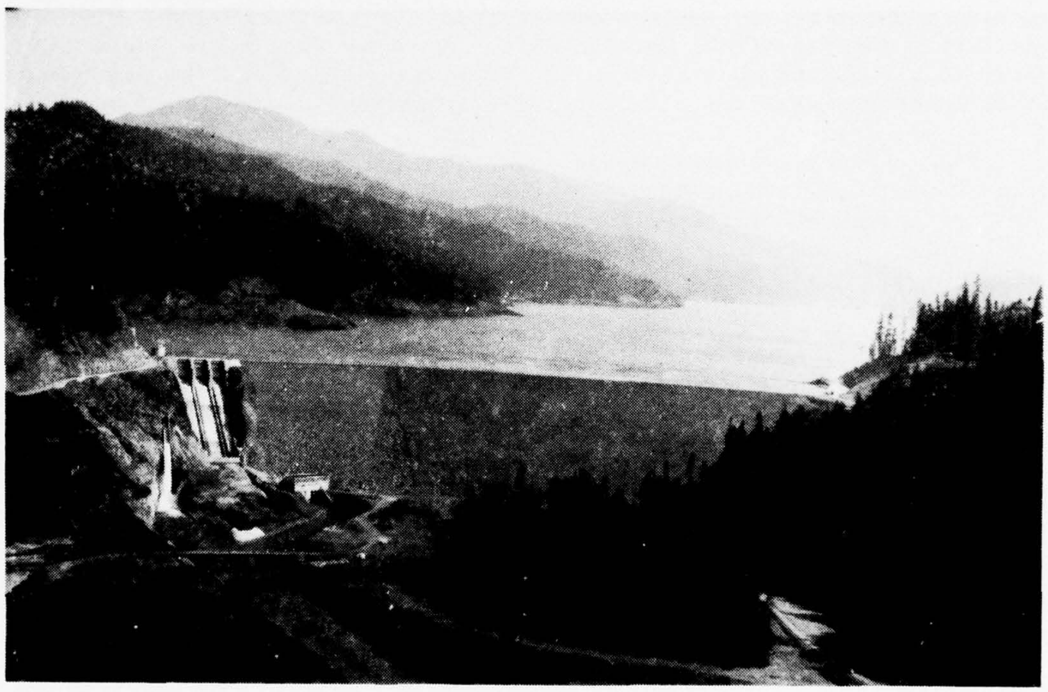


*Photo II-14. Hills Creek Dam on Middle Fork Willamette River. (Corps of Engineers photo)*

Hills Creek Dam, on the Middle Fork 25.7 miles upstream from Lookout Point Dam, was completed in 1962. Shortly before impoundment of water commenced, the river system upstream was chemically treated to reduce or, if possible, eliminate redside shiners, largescale suckers, and squawfish. To date, the redside shiner is the only undesirable species known to survive the treatment. It is becoming numerous and poses a threat to salmonid production in the reservoir and its tributaries.

Historically, more spring chinook salmon were produced in the North Fork than in any other Middle Fork tributary. However, about 1928 a 24-foot high dam was constructed on the North Fork at river mile 1.4. This structure, because of its inadequate fishway, had blocked the upstream migration of spring chinook prior to construction of downstream dams. At present it has no fishway at all.

Recurring introductions of bark and sawdust into the North Fork from the Hines Lumber Company mill were reduced in 1960, but pollution still occurs. Decomposition of the millwaste lowers dissolved oxygen concentrations in the river and reservoirs downstream. There are no other subbasin pollution sources seriously affecting fish.

Water rights for consumptive use of surface water total about 100 cfs (Table II-13). The volumes are about evenly divided for irrigation, industrial, and municipal uses. Diversion of most water occurs along the Middle Fork downstream from Dexter Dam. The amount of water diverted is more than offset by water released from the reservoir, thus, diversion has little adverse effect on fish life. An unscreened ditch diverting water to a log pond near river mile 3.8 is an exception. The water returns to Willamette River over a 6-foot falls at Springfield.

Past plans for tapping Waldo Lake to utilize its waters for downstream power development have been suppressed because of its high value for angling and other recreational uses.

Table II-13

*Appropriated surface water and minimum streamflow measurement data, Middle Fork Subbasin (cfs)*

| Stream Area | Appropriated Surface Water 1/ | | Instantaneous Minimum Flows Measured | | | |
|---|---|---|---|---|---|---|
| | Non-Consumptive | Consumptive | Instantaneous Discharge | Location | Date 2/ | Source 2/ |
| Middle Fork Willamette River downstream from Lookout Point Dam | 0.0 | 31 | 100 (daily mean) | 2.7 miles downstream from Dexter Dam | Nov. 25, 1960 (1946-1967) | USGS |
| Fall Creek System | 0.0 | 9.7 | 19 | River mile 6.1 | Dec. 1, 1936 (1935-1967) | USGS |
| Lost Creek System | - | 21 | 2.0 | River mile 1.7 | Sept. 8, 1965 | OSGC |
| Other tributaries to Middle Fork downstream from Lookout Point Dam | 0.5 | 17 | - | - | - | - |
| Middle Fork Willamette River upstream from Lookout Point Dam | 0.1 | 0.1 | 322 | 4.2 miles downstream from North Fork | Aug. 30, 1961 (1923-1967) | USGS |
| North Fork of Middle Fork Willamette R. System | 0.0 | 10 | 26 | River mile 1.0 | Oct. 14, 1939 (1909-1916) (1935-1967) | USGS |
| Salmon Creek System | 82 | 2.6 | 63 (freezeup) | River mile 5.0 | Jan. 8, 1937 (1933-1967) | USGS |
| Salt Creek System | 0.9 | 6.6 | 55 (freezeup) | River mile 0.7 | Jan. 8, 1937 (1933-1967) | USGS |
| Other tributaries to Middle Fork upstream from Lookout Point Dam | 9 | 1.8 | - | - | - | - |

1/ *Oregon State Water Resources Board records, April 1966.*
2/ *U. S. Geological Survey periods of available records are shown in parenthesis. Oregon State Game Commission listing is the lowest of flows measured monthly in low discharge periods of 1964 and 1965.*

## Developments Beneficial to Fish Resources

Table II-14 shows minimum streamflow stipulations established in the subbasin. Future appropriations may be made only for domestic or livestock uses from natural flows of the listed stream areas. Additionally, State Water Resources Board programming protects natural lakes, other than those privately owned, from substantial water withdrawals.

Table II-14

*Minimum streamflow stipulations established by the Oregon State Water Resources Board*

| Stream | Location | Minimum Flows (c.f.s.) 1/ Natural | Storage | Total |
|---|---|---|---|---|
| Middle Fork Willamette River and tributaries | Mouth | 640 | 1,475 | 2,115 |
| Middle Fork Willamette River and tributaries | Upstream from confluence with North Fork of Middle Fork Willamette River | 285 | 690 | 975 |
| Fall Creek and tributaries | Mouth | 40 | 470 | 510 |
| North Fork of Middle Fork Willamette River and tributaries | USGS Gage 1.0 mile upstream from mouth | 115 | - | 115 |

*1/ "Natural" minimum flow stipulations were set by the Oregon State Water Resources Board. The "storage" volumes are provided whenever possible as a part of the authorized navigation project purpose from U. S. Army Corps of Engineers dams located upstream.*

Recommendations for minimum streamflows have been made by Oregon State Game Commission. A listing of these is presented in Table II-15.

Two fish hatcheries are located on lower Salmon Creek at Oakridge. The one operated by the Fish Commission of Oregon rears anadromous fish from eggs of adults trapped at Dexter Dam. The adjacent Oregon State Game Commission hatchery rears mostly rainbow trout for stocking in the upper Willamette watershed. Fish liberations into subbasin waters in the 1961-65 interval are listed in Table II-16.

This subbasin contains 14 private stocked fish ponds. Most of these are not open to the public although fishing may be allowed in some on a fee basis.

Fall Creek Dam and Reservoir, completed by the Corps of Engineers in 1965, provides rearing area for spring chinook salmon and sport fishing opportunity for rainbow trout. Watershed tributaries upstream from Fall Creek Dam were chemically treated to remove nongame fish prior to impoundment of the reservoir. As a result of a successful rearing program in the impoundment, more than 4,000 spring chinook salmon returned to Fall Creek in 1969. This return may be compared to a presumably natural return of less than 100 adults in 1968.

Table II-15
*Minimum flows for fish life recommended to Oregon State Water Resources Board by Oregon State Game Commission (cfs) 1/*

| Stream | Location | Dec-May | June | July | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|
| Middle Fork Willamette R. | USGS Gage 14-1448 | 300 | 300 | 250 | 250 | 250 300 | 300 | 300 |
| " " " " | USGS Gage 14-1455 | 285 | 285 | 285 | 285 | 285 | 285 | 285 |
| " " " " | USGS Gage 14-1480 | 1,200 | 1,000 | 1,000 | 1,000 | 1,000 1,200 | 1,200 | 1,200 |
| " " " " | USGS Gage 14-1520 2/ | 1,500 | 1,025 | 1,025 | 1,025 | 1,025 1,500 | 1,500 | 1,500 |
| Big Willow Creek | Mouth | 8 | 3 2 | 1 0.5 | 0.5 | 0.5 | 0.5 | 5 8 |
| Buck Creek | " | 25 | 10 5 | 3.0 2 | 2 | 2 | 2 | 18 25 |
| Coal Creek | " | 45 | 40 30 | 20 15 | 10 | 10 | 10 | 30 45 |
| Coffeepot Creek | " | 13 | 8 4 | 2 | 1 | 1 | 1 | 8 13 |
| Fall Creek | USGS Gage 14-1503 | 125 | 75 50 | 25 | 25 | 25 125 | 125 | 125 |
| " " | USGS Gage 14-1510 2/ | 150 | 100 75 | 40 | 40 | 40 150 | 150 | 150 |
| Alder Creek | Mouth | 15 | 10 8 | 5 3 | 2.0 | 2.0 | 2.0 | 10 15 |
| Delp Creek | " | 30 | 20 12 | 8 5 | 3 | 3 | 3 | 20 30 |
| Hehe Creek | " | 35 | 25 15 | 8 6 | 4 | 4 | 4 | 20 35 |
| Pernot Creek | " | 15 | 8 4 | 2 | 1 | 1 | 1 | 10 15 |
| Little Fall Creek | " | 80 | 60 40 | 25 15 | 10 | 10 | 10 | 60 80 |
| North Fk. Fall Cr. | " | 15 | 10 6 | 3 2 | 1 | 1 | 1 | 10 15 |
| Portland Creek | " | 50 | 30 20 | 10 6 | 4 | 4 | 4 | 40 50 |
| Winberry Creek | " | 50 | 40 20 | 10 6 | 5 | 5 | 5 | 30 50 |
| N. Fk. Winberry Cr. | " | 25 | 20 10 | 6 3 | 2 | 2 | 2 | 15 25 |
| S. Fk. Winberry Cr. | " | 40 | 30 15 | 8 4 | 2 | 2 | 2 | 30 40 |
| Gold Creek | " | 20 | 10 4 | 2 1 | 0.5 | 0.5 | 0.5 | 12 20 |
| Hills Creek (Lower) | " | 12 | 8 4 | 2 | 1 | 1 | 1 | 6 12 |
| Hills Creek (Upper) | USGS Gage 14-1449 2/ | 70 | 60 40 | 25 | 25 | 20 | 20 | 50 70 |
| Larison Creek | Mouth | 10 | 6 3 | 2 | 1 | 1 | 1 | 6 10 |
| Lost Creek | " | 50 | 25 15 | 8 6 | 3 | 3 | 3 | 30 50 |
| " " | Just upstream from Guiley Cr. | 18 | 10 6 | 4 3.0 | 2 | 2 | 2 | 11 18 |
| Guiley Creek | Mouth | 15 | 7 4 | 2 | 1 | 1 | 1 | 10 15 |
| North Fork Willamette R. | USGS Gage 14-1475 2/ | 200 | 200 | 150 115 | 115 | 115 200 | 200 | 200 |
| " " " " | Just upstream from Plateau Cr. | 150 | 150 | 125 100 | 100 | 100 150 | 150 | 150 |
| Christy Creek | Mouth | 100 | 75 50 | 25 15 | 10 | 10 | 10 | 60 100 |
| Fisher Creek | " | 35 | 30 20 | 15 10 | 8 | 8 | 8 | 20 35 |
| Packard Creek | " | 12 | 8 4 | 2 | 1 | 1 | 1 | 8 12 |
| Salmon Creek | USGS Gage 14-1465 2/ | 175 | 175 | 125 100 | 100 | 100 175 | 175 | 175 |
| Black Creek | Mouth | 70 | 60 | 50 40 | 30 | 30 | 30 | 50 70 |
| Wall Creek | " | 25 | 20 12 | 8 5 | 3 | 3 | 3 | 15 25 |
| Salt Creek | " | 125 | 125 | 100 90 | 90 | 90 125 | 125 | 125 |
| Eagle Creek | " | 40 | 35 | 30 | 25 | 25 | 25 | 25 40 |
| S. Fk. Salt Creek | " | 25 | 15 10 | 7 5 | 3 | 3 | 3 | 15 25 |
| Simpson Creek | " | 25 | 15 10 | 6 4 | 2 | 2 | 2 | 15 25 |
| Staley Creek | " | 60 | 40 30 | 25 20 | 15 | 15 | 15 | 40 60 |
| Swift Creek | " | 80 | 70 60 | 50 40 | 30 | 30 | 30 | 50 80 |
| Windfall Creek | " | 10 | 4 2 | 0.5 | 0.5 | 0.5 | 0.5 | 8 10 |

*1/ Where 2 figures are shown, minimums change during the month.*
*2/ From listed gage to mouth of listed stream.*

Table II-16

*Numbers of fish stocked in Middle Fork Willamette Subbasin, 1961-1965*

| Stream system or lake | Species | Mean Length (Inches) | Number per pound | 1961 | 1962 | 1963 | 1964 | 1965 | Agency |
|---|---|---|---|---|---|---|---|---|---|
| Middle Fork Willamette | Spring Chinook | - | 12-27 | 1,460,000 | 1,185,000 | 2,455,700 | 3,916,100 | 1,750,900 | FCO |
| " " | " | - | 1,150 | | | | 170,500 | | " |
| " " | Coho | - | 16 | | 42,600 | 93,300 | | | " |
| " " | " | - | 1,250 | | | | | 200,000 | " |
| " " | Steelhead | - | 8 | 122,300 | 3,500 | | | | " |
| " " | " | - | 48-78 | | | 275,900 | 126,000 | | " |
| " " | Kokanee | 0-2 | - | | | | 6,900 | | OSGC |
| " " | Rainbow | 0-2 | - | 1,395,900 | | | | | " |
| " " | " | 2-4 | - | 58,600 | | | | | " |
| " " | " | 4-6 | - | 3,300 | | | | | " |
| " " | " | 8 & over | - | 118,600 | 130,800 | 126,000 | 306,900 | 91,200 | " |
| Fall Creek | Coho | - | 1,100-1,200 | | | 350,000 | | 410,000 | FCO |
| " " | Rainbow | 8 & over | - | 18,000 | 17,800 | 13,[illegible]00 | 13,200 | 10,000 | OSGC |
| " " | " | 4-6 | - | | | | | 189,800 | " |
| Waldo Lake | Brook Trout | 2-4 | - | 258,700 | 668,900 | 300,200 | 213,900 | 193,300 | " |
| " " | Kokanee | " | - | | | 175,000 | 219,200 | 337,100 | " |
| " " | Rainbow | 0-2 | - | 286,500 | 963,500 | 326,000 | | | " |
| " " | Rainbow | 2-4 | - | 3,700 | 100,000 | | 240,600 | 414,200 | " |
| " " | " | 4-6 | - | | | 54,900 | 103,100 | | " |
| Other Cascade Lakes | Brook Trout | 2-4 | - | 66,000 | 84,400 | 69,700 | 83,600 | 66,900 | " |
| " " | Golden " | " | - | | 900 | 3,400 | 2,000 | | " |
| " " | Rainbow | 2-4 | - | 52,900 | 58,000 | 640,800 | 74,400 | 78,500 | " |
| Dexter Res. | " | 8 & over | - | 6,100 | 10,000 | | | | " |
| Hills Cr. Res. | " | 0-2 | - | | | 245,800 | | | " |
| " " | " | 2-4 | - | 70,000 | 102,000 | 300,600 | 84,500 | 12,600 | " |
| " " | " | 4-6 | - | 308,600 | 43,200 | 6,200 | 200,200 | 201,400 | " |
| " " | " | 8 & over | - | | 38,700 | 200 | | | " |

## Present Economy

The subbasin provides an annual average of 16,000 spring chinook and a few winter steelhead to the Columbia River and Pacific Ocean commercial fisheries. This represents a catch of 277,000 pounds of fish valued at $155,000 annually.

Most sport catches of anadromous fish produced in the Middle Fork drainage are made in areas outside the subbasin, but the fishery in the Middle Fork is gaining in popularity and the catch there is expected to increase. Approximately 8,200 spring chinook and steelhead produced in the subbasin furnish an estimated 65,500 days of fishing valued at $393,000 annually.

Resident cutthroat or rainbow trout provide fishing in nearly all streams. Heaviest trout angling is absorbed by the larger streams where stocks are supplemented with hatchery rainbow. Subbasin streams contributed an estimated 52,500 days of trout fishing valued at $158,000 in 1965.

The Cascade lakes furnish angling through the summer season. Brook and rainbow trout are the main species harvested. They are stocked as fingerlings from airplanes. Kokanee are caught only in Waldo Lake. Good fishing has resulted from rainbow plants in Hills Creek Reservoir, and similar success is expected in Fall Creek Reservoir as long as numbers of nongame fish remain low.

An estimated 28,000 angler-days valued at $56,000 were exerted to harvest 132,000 trout from Hills Creek Reservoir in 1963. There are trout fisheries of considerable magnitude, but unmeasured, on numerous high Cascade lakes in the subbasin. The catch and angler use value of warm-water game fish is negligible.

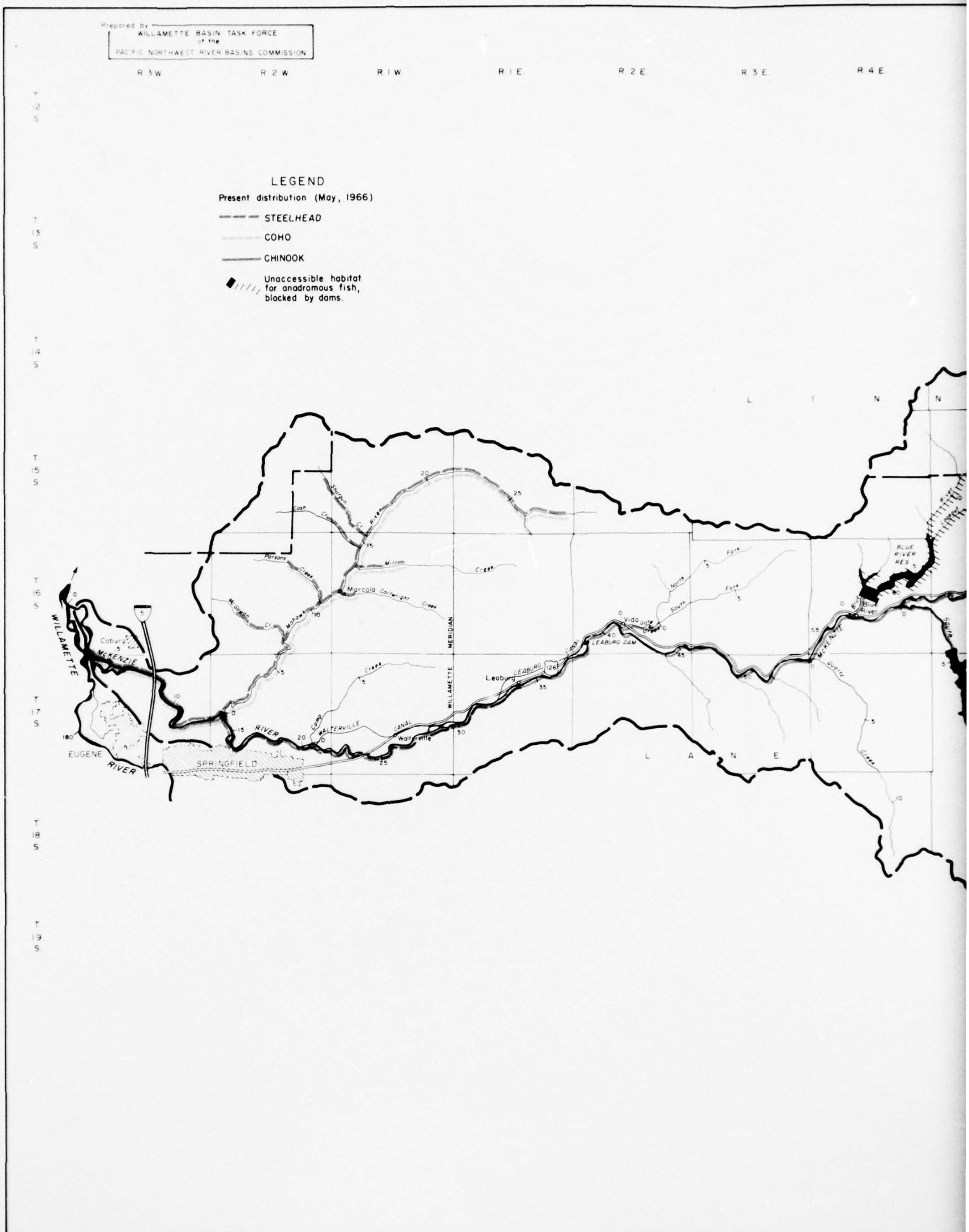
Nearly all streams in the McKenzie River system support important salmonoid fish populations (Map II-3). Reservoir habitat is provided by three Eugene Water and Electric Board impoundments, and by Cougar and Blue River Reservoirs of the U. S. Army Corps of Engineers. Approximately 90 lakes in the Cascade Range support trout fishing.

## Habitat

McKenzie River originates at Clear Lake near the Cascade summit and flows west for 90 miles before entering Willamette River at mile 175 near Eugene. The watershed area is 1,342 square miles (Map II-3). About 70 percent of the subbasin lies above the 2,000-foot elevation. Most streams are mountainous in character. Gradients are moderate to steep, and spawning gravel is plentiful. Summer streamflows are relatively high, partially due to extensive lava areas near the Cascade Range crest that act as subsurface reservoirs. Since 1944, average discharge of the McKenzie at a U. S. Geological Survey gage 7.1 miles upstream from the mouth has been about 6,000 cubic feet per second. The minimum flow recorded at this location was 1,080 cfs on August 19, 1966.

Summer stream temperatures seldom exceed 65° F except in the lower watershed. Water temperatures occasionally reach 70° F in the lower river and 75° F in the Mohawk River system, tributary to the McKenzie at river mile 14.0.

*Photo II-15. McKenzie River originates at Clear Lake near the Cascade Summit. (U. S. Forest Service photo)*



Prepared by
WILLAMETTE BASIN TASK FORCE
of the
PACIFIC NORTHWEST RIVER BASINS COMMISSION
R 3 W
R 2 W
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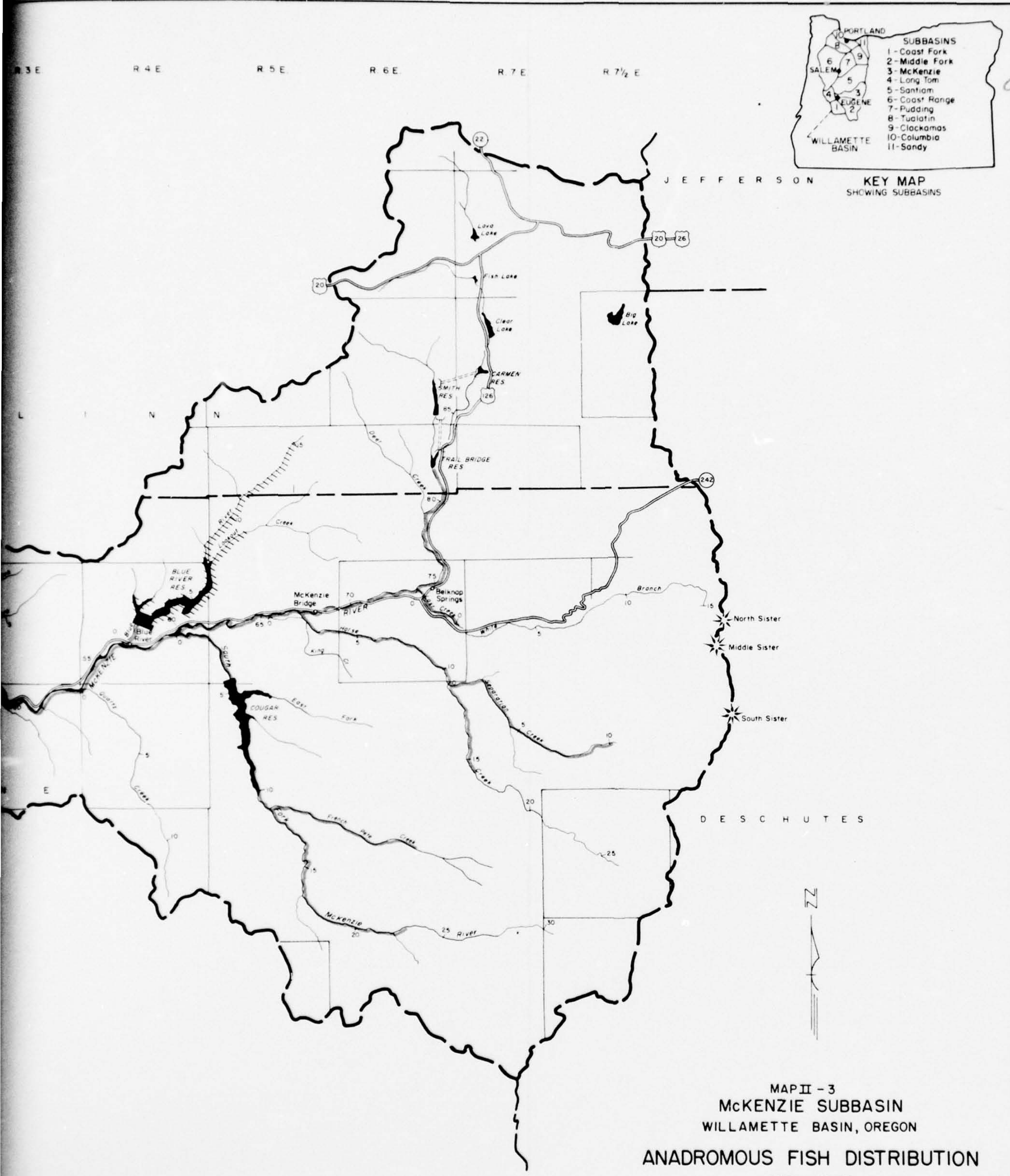
R 4 E
T 12 S
T 13 S
T 14 S
T 15 S
T 16 S
T 17 S
T 18 S
T 19 S
LEGEND
Present distribution (May, 1966)
STEELHEAD
COHO
CHINOOK
Unaccessible habitat for anadromous fish, blocked by dams.
L I N N
L A N E
WILLAMETTE
McKENZIE
Coburg
EUGENE
RIVER
SPRINGFIELD
Marcola
Mohawk
Parsons Creek
Mill Creek
Cartwright Creek
WILLAMETTE MERIDIAN
Walterville
WALTERVILLE CANAL
Leaburg
LEABURG CANAL
LEABURG DAM
Vida
North Fork
South Fork
BLUE RIVER RES.
Blue River
McKENZIE




MAP II - 3
McKENZIE SUBBASIN
WILLAMETTE BASIN, OREGON

ANADROMOUS FISH DISTRIBUTION

APRIL 1967

SCALE IN MILES

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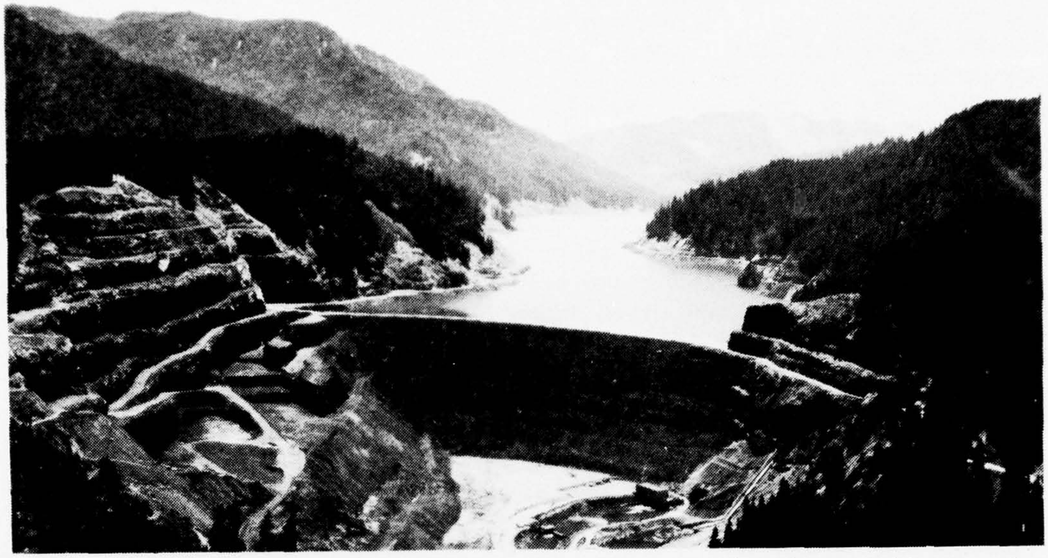


*Photo II-16. Cougar Dam on the South Fork McKenzie River. (Corps of Engineers photo)*

*Photo II-17. McKenzie River, with moderate to steep gradients and plentiful spawning gravel, supports important game fish populations. (Oregon State Highway Department photo)*

There are impassable falls in upper portions of several streams, but there is little habitat for anadromous fish above them. Prior to construction of Trail Bridge Dam in 1963, 60-foot Tamolitch Falls at river mile 85.8 was the upper limit of anadromous fish distribution. Now the upper limit is a low dam at river mile 81.6 immediately downstream from Trail Bridge Dam. This dam is a "water velocity barrier" for diverting spring chinook adults into an adjacent artificial spawning channel. The channel was provided to mitigate loss of spring chinook habitat blocked by Trail Bridge and Smith River Dams (Photo II-18).

At least 90 Cascade lakes in the subbasin offer excellent trout habitat. Big Lake, the largest, covers 223 surface acres. Trail Bridge Reservoir, 120 surface acres; Smith River Reservoir, 170 surface acres; and Carmen Reservoir, 31 surface acres, are Eugene Water and Electric Board impoundments in the upper McKenzie River watershed providing additional waters for salmonids and angling. Cougar Dam, which was completed in 1963 on the South Fork of McKenzie River at river mile 4.5, impounds 1,280 surface acres. Blue River Dam, with a 975-acre impoundment at river mile 1.7 on Blue River, was completed in 1968.

### Species and Distribution

About 50 percent of the spring chinook which ascend Willamette Falls, or about 14,500 fish, enter McKenzie River. Principal spawning streams, in order of descending importance are: McKenzie River, South Fork McKenzie, Horse Creek, Lost Creek, and Gate Creek. Small numbers of spring chinook utilized Blue River but were displaced by Blue River Dam.

Annual spawning populations of coho and winter steelhead total about 50 and 350 fish, respectively. The coho are from recent plants and were first recorded as spawning in the subbasin in the fall of 1964. Most of the winter steelhead enter the Mohawk River system. Why there is only a token run of steelhead in the McKenzie system above the Mohawk is unknown, since the large number of spring chinook that use this reach is an indication that habitat is excellent. Map II-3 shows known anadromous fish distribution in the McKenzie drainage.

Rainbow and cutthroat trout exist in moderate to high numbers throughout the subbasin. Native rainbow, traditionally called "redsides," normally range from 13 to 16 inches long when mature and occasionally exceed 24 inches in the McKenzie. Relatively low numbers of Dolly Varden and whitefish inhabit most of the larger, high-elevation streams. Stocked brook and rainbow trout are the predominant species in the Cascade lakes although a few of these lakes contain native cutthroat and planted golden trout. Kokanee salmon are well established in Big Lake. Stocked rainbow trout are prevalent in the subbasin's reservoirs.

Cool water temperatures limit warm-water game fish and nongame fish populations in most of the watershed. Dace, sculpins, and suckers are the only nongame species above the mouth of Blue River. Moderate numbers of squawfish, dace, sculpins, suckers, lamprey, redside shiners, and chiselmouth are present in the lower McKenzie system upstream to and including Mohawk River.

## Developments and Conditions Adversely Affecting Fish Resources

The South Fork is McKenzie River's major spring chinook spawning tributary. In 1958, prior to construction of Cougar Dam, the South Fork run was calculated to be 4,400 fish. Table II-17 lists numbers of adults trapped at the damsite and released above the reservoir since 1960. Flow conditions below the dam are suspected to be the cause for the low numbers trapped in 1965.

Table II-17

*Adult spring chinook counts at Cougar Dam and Carmen-Smith Spawning Channel*

| Year | Cougar Dam Trap | Carmen-Smith Spawning Channel |
|---|---|---|
| 1960 | 629 | - |
| 1961 | 1,046 | 169 |
| 1962 | 2,121 | 121 |
| 1963 | 2,050 | 160 |
| 1964 | 740 | 169 |
| 1965 | 68 | 56 |
| 1966 | 263 | 87 |

*Source: Fish Commission of Oregon*

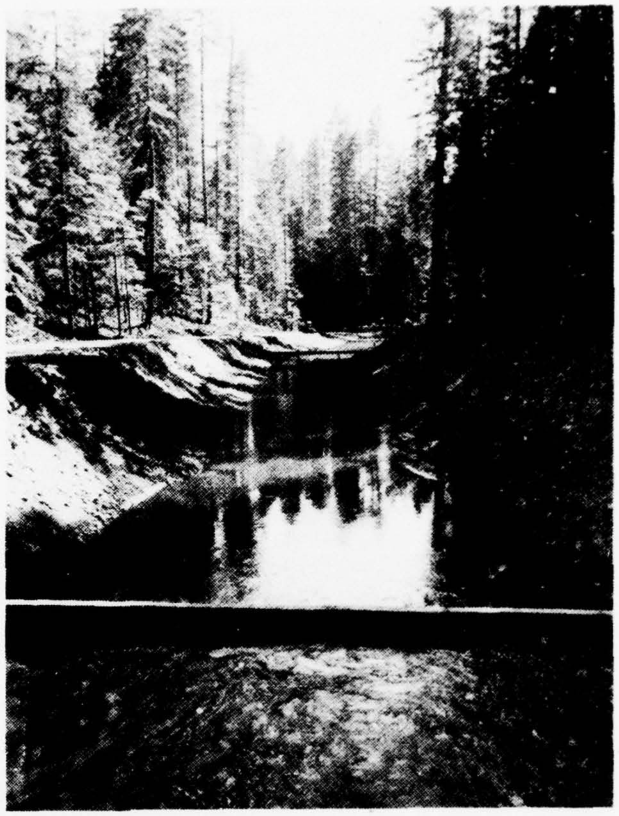
An evaluation of fish passage facilities at Cougar Dam has shown that spring chinook salmon, the only anadromous fish involved, have failed to maintain their numbers. On recommendation of the State and Federal fishery agencies, passage has been abandoned and hatchery production will be substituted as mitigation.

Construction associated with Cougar Dam resulted in high silt loads in lower South Fork. Silt put in suspension during the 1964-65 floods settled slowly in Cougar Reservoir; consequently, water released throughout the following spring and summer was turbid.

Sand and gravel mining along the lower McKenzie periodically cause high turbidity that is detrimental to salmonid spawning and rearing, and angling. Logging and road building create similar stream siltation problems in most years.

*Photo II-18*

*Artificial spawning channel developed in connection with Carmen-Smith Hydroelectric Project. (U.S. Forest Service photo)*



Blue River and Trail Bridge Dams eliminate approximately five miles of stream formerly utilized by spring chinook. Numbers of chinook entering the artificial spawning channel below Trail Bridge Dam since its construction in 1961 are included in Table II-17. Efficiency of this facility is also being evaluated.

Two Eugene Water and Electric Board canals remove large volumes of water from the McKenzie for power generation. Walterville Canal, the lower diversion, begins at river mile 28.4 and re-enters at river mile 21.0; this diversion is at stream level and requires no dam. Leaburg Canal, the upper diversion, begins at river mile 38.9 and re-enters the McKenzie at river mile 33.3. Leaburg Dam, the 20-foot high diversion structure, is provided with two ladders. However, about 200 spring chinook spawn within 150 yards below the dam each year, indicating that a passage problem exists.

Walterville and Leaburg Canals, since their construction in 1911 and 1930, respectively, have created other problems affecting spring chinook. The 13 miles of river channel bypassed by the canals contain extensive gravel which is heavily used by spawning chinook. Spawning occurs in September and October, normally the season of lowest streamflows. During this period, substantial amounts of water are removed by the two canals, leaving minimal flows in the river for the spawning salmon. Joint studies conducted by Fish Commission of Oregon and Oregon State Game Commission biologists in 1952 and 1955 resulted in agreements with Eugene Water and Electric Board whereby minimum flows are provided in the two river areas. These are better than prior conditions, but storage provisions should be made to further increase these minimum flows during spawning seasons.

Large numbers of spring chinook are attracted into Walterville and Leaburg Canals. The Walterville powerplant is located 2 miles above the lower end of its canal, whereas the Leaburg powerplant is 200 yards above the lower end of its canal. Flows through the powerplants are sometimes purposefully reduced so the fish will drop downstream and return to the river. The greater problem is at Walterville powerplant because of its longer tailrace canal. An additional small canal built specifically for fish passage, connects the Walterville Canal with the river and partially alleviates the problem.

Neither Walterville nor Leaburg Canal is screened to prevent loss of fish migrating downstream. Mortality studies conducted by the Oregon State Game Commission at the two powerplants in 1956 revealed significant losses of fish as a result of passage through the turbines.

The Federal Power Commission included in the license granted for these projects provisions that at least agreed-upon minimum flows be allowed to pass down McKenzie River past Walterville Canal and at least 500 cfs be permitted past Leaburg Dam at all times. Specification for construction, maintenance, and operation of permanent upstream and downstream fish protection devices at the entrance and exit of the Leaburg Canal, and the entrance to Walterville Canal were also included in the license.

Under present conditions, consumptive use of surface water (Table II-18) does not seriously impair fish habitat.

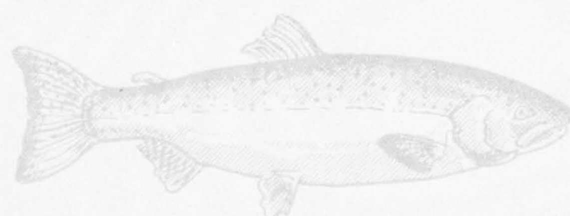


Table II-18

*Appropriated surface water and minimum streamflow measurement data, McKenzie Subbasin (cfs)*

| Stream Area | Appropriated Surface Water 1/ | | Instantaneous Minimum Flows Measured | | | |
|---|---|---|---|---|---|---|
| | Non-Consumptive | Consumptive | Instantaneous Discharge | Location | Date 2/ | Source 2/ |
| McKenzie River | 9,478 | 688 | 1,080 | River Mile 7.1 | Aug. 19, 1966 (1944-1967) | USGS |
| Blue River System | 1.0 | 0.05 | 11 | River Mile 5.1 | Aug. 21, 22, 1961 (1935-1967) | USGS |
| Gate Creek System | 40 | 0.3 | 16 | Mouth | Sept. 2, 1965 | OSGC |
| Horse Creek System | 0.1 | 0.7 | 230 | River Mile 3.4 | Oct. 5, 6, 1967 (1962-1967) | USGS |
| Mohawk River System | 0.2 | 5.4 | 8.2 | River Mile 1.6 | Sept. 9, 1967 (1935-52) (1963-67) | USGS |
| South Fork McKenzie River System | 0.0 | 0.0 | 17 | 0.6 mile downstream from Cougar Dam | Nov. 18, 1965 (1947-1967) | USGS |
| Other tributaries to the McKenzie River | 1,020 | 46 | - | - | - | - |

1/ *Oregon State Water Resources Board records, April 1966.*

2/ *U. S. Geological Survey periods of available records are shown in parenthesis. Oregon State Game Commission listing is the lowest of flows measured monthly in low discharge periods of 1964 and 1965.*

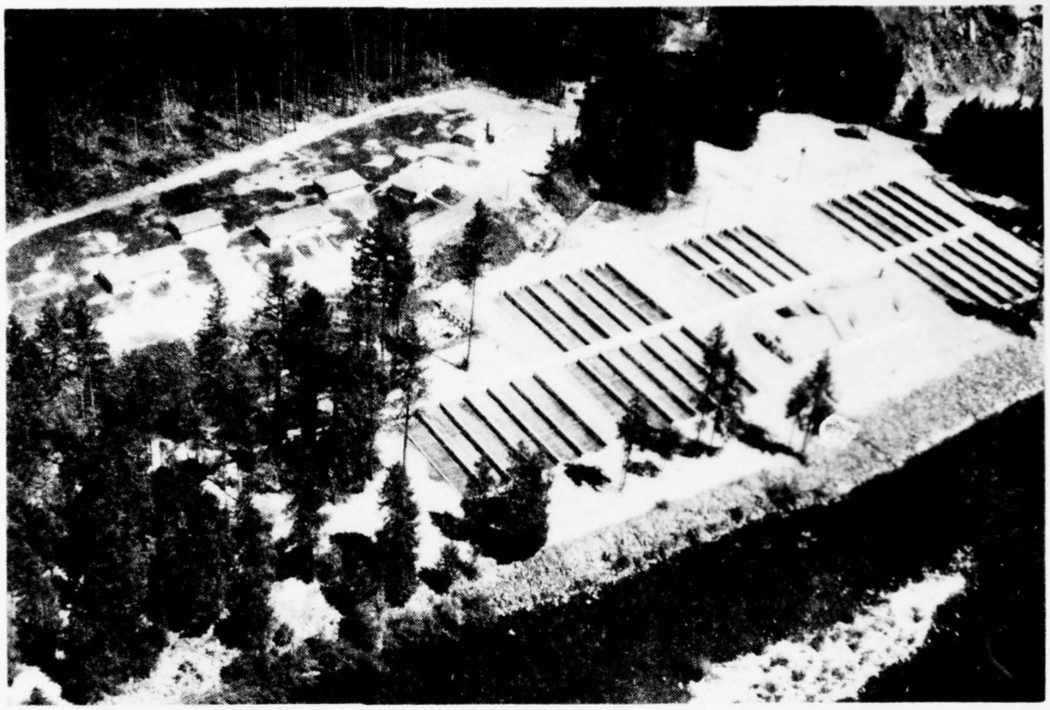


*Photo II-19. Oregon State Game Commission operates this large trout hatchery near Leaburg Dam. (Corps of Engineers photo)*

## Developments Beneficial to Fish Resources

Oregon's largest trout hatchery, located at Leaburg Dam, was constructed by the Corps of Engineers to mitigate project-caused loss of spawning and rearing areas for trout. The hatchery is operated by the Oregon State Game Commission. Rainbow trout, the predominant species reared there, are released into the McKenzie system and other waters of the state. Another hatchery 2.5 miles downstream is managed by the Fish Commission of Oregon. This installation rears juvenile spring chinook salmon. The young salmon are subsequently released into the McKenzie. Fish liberations in streams of the subbasin for the 1961-65 period are listed in Table II-19.

AD-A036 749 PACIFIC NORTHWEST RIVER BASINS COMMISSION VANCOUVER WASH F/G 8/6
THE WILLAMETTE BASIN COMPREHENSIVE STUDY OF WATER AND RELATED L--ETC(U)
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Table II-19

*Numbers of fish stocked in McKenzie Subbasin, 1961-65*

| Stream System or Lake | Species | Mean Length (Inches) | Number per pound | 1961 | 1962 | 1963 | 1964 | 1965 | Agency |
|---|---|---|---|---|---|---|---|---|---|
| McKenzie | Fall Chinook | - | 943-981 | | | | 2,279,800 | | USFWS |
| " | Spring Chinook | - | 19-42 | 520,400 | 145,100 | 445,600 | 479,200 | 634,500 | FCO |
| " | " " | - | 443-978 | | | 32,600 | | 63,700 | " |
| " | Coho | - | 17 | | | | | 10,000 | " |
| " | " | - | 1100-1250 | | 233,600 | 500,000 | | 500,000 | " |
| " | Rainbow | 8 & over | - | 164,000 | 179,900 | 180,000 | 119,900 | 162,700 | OSGC |
| " | " | 4-6 | - | | | | | 60,400 | " |
| Big Lake | Brook trout | 2-4 | - | 26,000 | 24,800 | 25,000 | 25,000 | | OSGC |
| " " | Kokanee | " | - | 38,500 | 49,800 | 24,900 | 25,000 | 25,400 | " |
| " " | Rainbow | " | - | | 37,100 | | | | " |
| Clear Lake | Brook trout | 2-4 | - | | 50,000 | 40,000 | | | " |
| " " | Rainbow | " | - | | | 25,000 | | 57,000 | " |
| " " | " | 4-6 | - | 21,400 | | 25,000 | 50,000 | | " |
| " " | " | 8 & over | - | 31,000 | 30,100 | 30,000 | 31,800 | 40,000 | " |
| Other Cascade Lakes | Brook trout | 2-4 | - | 82,800 | 81,900 | 67,800 | 79,000 | 72,000 | " |
| " " | Golden trout | " | - | 1,200 | 600 | 1,900 | 1,700 | | " |
| " " | Rainbow | " | - | 15,600 | 67,800 | 38,000 | 17,400 | 27,000 | " |
| " " | " | 4-6 | - | | | | | 20,000 | " |
| " " | " | 8 & over | - | | | | | 11,200 | " |
| Carmen-Smith Reservoirs | " | 0-2 | - | | | 650,100 | | | OSGC |
| " " | " | 2-4 | - | | | 96,000 | | 113,900 | " |
| " " | " | 4-6 | - | | | | 71,700 | | " |
| " " | " | 8 & over | - | | | 28,100 | 33,500 | 23,100 | " |
| Cougar Reservoir | " | " | - | | | | 9,100 | 30,000 | " |
| " " | " | 4-6 | - | | | | | 49,600 | " |
| " " | " | 2-4 | - | | | | | 100,300 | " |

Table II-20 lists minimum streamflow stipulations established in the subbasin. Future appropriations may be made only for domestic or livestock uses from natural flows of these stream areas. Additionally, the McKenzie River's flows above river mile 76.9, including tributary Smith River, are protected by State Water Resources Board from future appropriations for nearly all consumptive uses. Natural lakes, other than those privately owned, are also protected from substantial water withdrawals.

Table II-20
*Minimum streamflow stipulations established by Oregon State Water Resources Board*

| Stream 1/ | Location | Minimum Flows (c.f.s.) 2/ | | |
|---|---|---|---|---|
| | | Natural | Storage | Total |
| McKenzie River | Upstream from Interstate 5 Highway | 1,025 | 700 | 1,725 |
| McKenzie River | Upstream from USGS Gage 14-1625 at River Mile 47.7 | 1,400 | 580 | 1,980 |
| Mohawk River | Upstream from mouth | 20 | - | 20 |
| Gate Creek | Upstream from mouth | 20 | - | 20 |
| Blue River | Upstream from mouth | 30 | 350 | 380 |
| South Fork McKenzie River | Upstream from mouth | 200 | 230 | 430 |

1/ *Includes all tributaries above the listed locations.*
2/ *"Natural" minimum flow stipulations were set by the Oregon State Water Resources Board. The "storage" volumes are provided in addition whenever possible from U. S. Army Corps of Engineers dams located upstream as a part of the authorized navigation project.*

This subbasin contains 20 private stocked fish ponds. These are not usually open to the public, but some fishing may be allowed on a fee basis.

Table II-21 includes the minimum streamflow levels recommended by the Oregon State Game Commission for streams of this subbasin.

Table II-21

*Minimum flows for fish life recommended to Oregon State Water Resources Board by Oregon State Game Commission (cfs) 1/*

| Stream | Location | Dec.-May | June | July | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|
| McKenzie River | USGS Gage 14-1588.5 | 750 | 750 | 750 | 650 | 650 750 | 750 | 750 |
| " " | USGS Gage 14-1590 | 1,200 | 1,200 | 1,200 | 1,000 | 1,000 1,200 | 1,200 | 1,200 |
| " " | USGS Gage 14-1625 | 2,000 | 2,000 | 2,000 | 1,400 | 1,400 2,000 | 2,000 | 2,000 |
| " " | USGS Gage 14-1655 2/ | 2,000 | 2,000 | 2,000 | 1,025 | 1,025 2,000 | 2,000 | 2,000 |
| Blue River | Mouth | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| " " | USGS Gage 14-1611 | 90 | 50 30 | 25 20 | 15 | 12 | 12 | 50 90 |
| Cook Creek | Mouth | 25 | 15 8 | 4 2 | 1 | 1 | 1 | 20 25 |
| Lookout Creek | USGS Gage 14-1615 2/ | 60 | 30 20 | 15 12 | 9 | 9 | 9 | 40 60 |
| McRae Creek | Mouth | 17 | 10 6 | 3 2 | 1 | 1 | 1 | 12 17 |
| Quartz Creek | " | 20 | 12 8 | 6 3 | 2.0 | 2.0 | 2.0 | 12 20 |
| Quentin Creek | " | 25 | 15 10 | 5 3 | 1 | 1 | 1 | 20 25 |
| Simmonds Creek | " | 15 | 10 5 | 3 1 | 0.5 | 0.5 | 0.5 | 10 15 |
| Tidbits Creek | " | 25 | 15 12 | 8 5 | 3 | 2 | 2 | 20 25 |
| Camp Creek | " | 30 | 10 4 | 2 1 | 0.5 | 0.5 | 0.5 | 25 30 |
| Deer Creek (Lower) | " | 40 | 20 12 | 9 6 | 4 | 4 | 4 | 30 40 |
| Deer Creek (Upper) | " | 80 | 30 18 | 15 12 | 10 | 10 | 10 | 40 80 |
| Elk Creek | " | 8 | 1 | 0.5 | 0.5 | 0.5 | 0.5 | 4 [illegible] |
| Ennis Creek | " | 18 | 6 4 | 3 2 | 2 | 2 | 2 | 10 18 |
| Finn Creek | " | 12 | 3 2 | 2.0 1 | 1.0 | 1.0 | 1.0 | 7 12 |
| Gate Creek | " | 80 | 50 35 | 25 20 | 20 | 20 | 20 | 50 80 |
| N. Fk. Gate Creek | " | 45 | 30 20 | 15 12 | 10 | 10 | 10 | 30 45 |
| S. Fk. Gate Creek | " | 35 | 20 15 | 10 8 | 6 | 6 | 6 | 20 35 |
| Holden Creek | " | 12 | 3 1.5 | 1 | 0.5 | 0.5 | 0.5 | 8 12 |
| Horse Creek | USGS Gage 14-1591 2/ | 300 | 300 | 300 | 250 | 250 300 | 300 | 300 |
| King Creek | Mouth | 18 | 3 1 | 1 | 1 | 1 | 1 | 14 18 |
| Indian Creek | " | 10 | 4 2 | 2 | 2.0 | 2.0 | 2.0 | 6 10 |
| Kink Creek | " | 18 | 4 3 | 2 | 1 | 1 | 1 | 10 18 |
| Lost Creek | " | 150 | 100 | 100 | 100 | 150 | 150 | 150 |
| Marten Creek | " | 30 | 15 10 | 8 6 | 4 | 4 | 4 | 20 30 |
| Mohawk River | USGS Gage 14-1650 2/ | 200 | 100 60 | 40 25 | 20 | 20 | 20 | 100 200 |
| " " | River Mile 21 | 80 | 30 20 | 15 12 | 10 7 | 7 | 7 | 60 80 |
| Cartwright Creek | Mouth | 12 | 5 3.0 | 2 | 1 | 0.5 | 0.5 | 8 12 |
| Cash Creek | " | 15 | 3 2.0 | 1 | 0.5 | 0.5 | 0.5 | 10 15 |
| Drury Creek | " | 8 | 2 | 1 | 0.5 | 0.5 | 0.5 | 6 8 |
| McGowan Creek | " | 17 | 2 1 | 1 | 0.5 | 0.5 | 0.5 | 12 17 |
| Mill Creek | " | 50 | 15 9 | 7 5 | 4 | 3 | 3 | 30 50 |
| Parsons Creek | " | 25 | 2 1 | 0.5 | 0.5 | 0.5 | 0.5 | 20 25 |
| Shotgun Creek | " | 25 | 8 4 | 3 | 2 | 2 | 2 | 20 25 |
| Olallie Creek | " | 100 | 75 | 75 | 75 | 75 | 75 | 75 100 |
| Quartz Creek | " | 60 | 25 18 | 12 10 | 8 | 8 | 8 | 40 [illegible] |
| Scott Creek | " | 20 | 8 3 | 3 | 3 | 3 | 3 | 15 20 |
| S. Fk. McKenzie River | USGS Gage 14-1592 | 250 | 250 | 250 | 200 | 200 250 | 250 | 250 |
| " " " " | USGS Gage 14-1595 2/ | 400 | 400 | 250 | 250 | 250 400 | 400 | 400 |
| Augusta Creek | Mouth | 40 | 25 15 | 6 4 | 3 | 3 | 3 | 25 40 |
| Elk Creek | " | 50 | 30 20 | 15 12 | 8 | 8 | 8 | 30 50 |
| East Fork | " | 50 | 30 20 | 10 6 | 4 | 4 | 4 | 30 50 |
| French Pete Creek | " | 60 | 40 30 | 20 15 | 8 | 8 | 8 | 40 60 |
| Rebel Creek | " | 15 | 8 5 | 2 | 2 | 2 | 2 | 10 15 |
| Roaring River | Mouth | 70 | 50 | 50 | 50 | 50 | 50 | 50 70 |
| McBee Creek | " | 30 | 20 15 | 1[illegible] | 8 | 8 | 8 | 20 30 |

1/ *Where 2 figures are shown, minimums change during the month.*
2/ *From listed gage to mouth of listed stream.*

## Present Economy

Streams of the subbasin provide an average annual catch in the Columbia River and Pacific Ocean commercial fisheries of 39,000 spring chinook salmon valued at $380,000. The commercial catch of coho and steelhead is estimated at 150 fish valued at $400 annually. This is a total commercial catch of 668,000 pounds annually.

Light to moderate sport angling for spring chinook salmon is concentrated between the mouth of McKenzie River and Leaburg Dam. This fishery, conducted from both boats and the banks is gradually gaining in popularity. The sport catch of coho and steelhead is insignificant. In 1965 the subbasin furnished about 19,000 spring chinook salmon and small numbers of steelhead and coho to the McKenzie, lower Willamette River, Columbia River, and Pacific Ocean sport fisheries providing an estimated 155,000 angler-days of fishing valued at $930,000.

The widely known McKenzie River trout fishery is a substantial economic asset to McKenzie Subbasin. Both native "redsides" and hatchery rainbow are caught in large numbers. Resident cutthroat and rainbow trout provide additional fishing in nearly all streams of the basin. Native stocks are supplemented with hatchery rainbow in most of the larger streams (Table II-19). Trout fishing is popular in Cascade lakes from late May through October. Most of these lakes are stocked with trout fry from the air. Cougar, Trail Bridge, Carmen, and Smith Reservoirs receive moderate to heavy angling pressure for stocked and resident trout. An estimated 109,500 angler days valued at $328,000 are expended each season on trout streams of the subbasin. Lakes and reservoirs provide an estimated 6,900 trout angler days valued at $14,000 annually. There is practically no angling for warm-water species.

*Photo II-20. Big Lake, one of the many Cascade lakes fed by melting snows. (Oregon State Highway Department photo)*

*Photo II-21. Scott Lake, a popular spot for anglers, is close to the McKenzie Highway. (Oregon State Highway Department photo)*

## SUBBASIN 4 - LONG TOM

### Habitat

Long Tom River, 55 miles long, enters Willamette River from the west at river mile 149 between Corvallis and Eugene, and drains 410 square miles (Map II-4). Streamflows in the subbasin are low and warm in summer months, being typical of west-side Willamette River tributaries. Less than half of the 700 miles of stream in the subbasin maintain perennial flows. Only the upper portions of Long Tom River and some of its tributaries flow from the Coast Range mountains, thus 95 percent of the drainage area lies below the 1,000-foot elevation.

Stream temperatures in summer months commonly exceed 75° F. Some of the highest occur in the section of Long Tom River between its mouth and Fern Ridge Reservoir. In this area, water temperatures during the summer generally range from 70° to 80° F and have been recorded as high as 84° F.

Fern Ridge Reservoir was constructed in 1941 at mile 25.7 on Long Tom River by the U. S. Army Corps of Engineers. The unladdered earthen dam, 46 feet high, forms an impoundment of 10,400 surface acres. Although built for flood control, navigation, and irrigation, the reservoir is heavily used for angling and other forms of recreation.

*Photo II-22. Fern Ridge Reservoir is favorable habitat for warm-water fish, and supports minor populations of nongame fish. (Oregon State Highway Department photo)*

Immediately downstream from Fern Ridge Dam is a large borrow pit which supplied construction material for the dam. The pit is filled with water and offers good habitat for fish. More anglers use it than use the reservoir.

Numerous sites for small reservoirs are scattered throughout the watershed. Some of these, if developed, could create favorable fish habitat. Impoundments most beneficial would be those which would improve downstream flows.

## Species and Distribution

No anadromous fish use the Long Tom drainage. Because of naturally poor summer rearing conditions, it is doubtful if these species were ever present in significant numbers.

Native cutthroat trout exist in moderate numbers in all streams maintaining perennial flows despite unfavorable summer water conditions. These fish have adapted themselves to survive in the system. Most other salmonids could not tolerate the high water temperatures in the summer if introduced into the subbasin. Cutthroat also inhabit Fern Ridge Reservoir, but their numbers are limited by competition from warm-water game fish and nongame fish.

Bullhead catfish, crappie, and largemouth bass are the predominant warm-water game fish in Fern Ridge Reservoir. Bluegill and pumpkinseed are less common inhabitants. Several species, particularly white crappie, maintain substantial populations in the river below the reservoir. Fish species composition in the adjacent borrow pit is similar to that in the reservoir and river below.

Nongame species, such as suckers, squawfish, carp, and redside shiners, are numerous in the lower Long Tom system and in Fern Ridge Reservoir and its tributaries.

*Photo II-23. Gill-netted sample of fish from Fern Ridge Reservoir. (Bureau of Commercial Fisheries photo)*

*Photo II-24. Long Tom River channel attracts local fishermen. (Oregon State Game Commission photo)*

## Developments and Conditions Adversely Affecting Fish Resources

Fern Ridge Reservoir is favorable habitat for nongame fish that compete with more desirable game species. Reduction of water levels for flood control and annual withdrawals for navigation and irrigation further limits the production of game fish. The release of warm water from the reservoir contributes to the high temperatures downstream. These high temperatures limit or prohibit the production of cold-water species and promote the production of warm-water and nongame fish.

A laddered concrete dam, 10 feet high, stands in Long Tom River at Monroe. Two unladdered dams, 6 and 10 feet high, are located between Monroe and Fern Ridge Reservoir. These latter two barriers block the upstream migration of salmonids, but are not a serious problem since there is little spawning area between them and Fern Ridge Dam.

There are numerous withdrawals of water from subbasin streams for consumptive use. Water rights have been issued for the consumptive use of about 130 cfs (Table II-22). Most surface water rights are for small irrigation withdrawals.

Table II-22

*Appropriated surface water and minimum streamflow measurement data, Long Tom Subbasin (cfs)*

| Stream Area | Appropriated Surface Water 1/ | | Instantaneous Minimum Flows Measured | | | |
|---|---|---|---|---|---|---|
| | Non-Consumptive | Consumptive | Instantaneous Discharge | Location | Date 2/ | Source |
| Long Tom River downstream from Fern Ridge Dam | 0.0 | 22 | 0 | At Monroe, River mile 6.8 | Oct. 20-22, 1944 (1927-1967) | USGS |
| Tributaries to Long Tom R. downstream from Fern Ridge Dam | 0.1 | 29 | - | - | - | - |
| Long Tom River upstream from Fern Ridge Dam | 0.0 | 9.8 | 39 | Near Noti, River mile 37.4 | Aug. 26, 1967 (1935-1967) | USGS |
| Tributaries to Long Tom R. upstream from Fern Ridge Dam | 1.5 | 69 | - | - | - | - |

1/ *Oregon State Water Resources Board records, April 1966*

2/ *Periods of available records are shown in parenthesis.*

## Developments Beneficial to Fish Resources

Fern Ridge Reservoir and its adjoining borrow pit furnish extensive game fish habitat. Minimum releases of 30 cfs are made from the impoundment in summer months. These flows provide favorable habitat for warm-water game fish in the river below. Minimum streamflows recommended by Oregon State Game Commission are listed in Table II-23.

In 1949, Fern Ridge Reservoir was chemically treated to remove large numbers of nongame fish. It was subsequently restocked with game species. Similar treatment may be repeated periodically as the need arises.

Oregon State Water Resources Board has stipulated minimum flow of 370 cfs, from storage, at Monroe.

Table II-24 lists trout releases between 1961 and 1965. No anadromous fish are stocked in the subbasin.

This subbasin contains 21 private stocked fish ponds and one private hatchery. These are not usually open to the public, but on some, fishing may be allowed on a fee basis.

## Present Economy

Fishing pressure is heavy on Fern Ridge Reservoir and the borrow pit below the dam. Cutthroat trout, largemouth bass, bullhead catfish, bluegill, and crappie furnish most of the catch. Warm-water game fish and trout are also taken in the river immediately below the reservoir. Six smaller borrow pits along the west side of Highway 99W between Eugene and Junction City provide additional warm-water game fish angling. The warm water and reservoir fishery provided an estimated 30,000 angler days of fishing valued at $45,000 annually in 1965.

Approximately 1,300 trout were caught in subbasin streams in 1965. The harvest includes stocked rainbow trout of catchable size liberated in upper Long Tom River. Trout angling pressure occurs mostly in the spring shortly after stocking. Many cutthroat trout are caught incidentally by bait fishermen angling for warm-water game fish in Fern Ridge Reservoir. Stream caught trout furnished an estimated 900 angler-days of fishing valued at $2,700 in 1965.

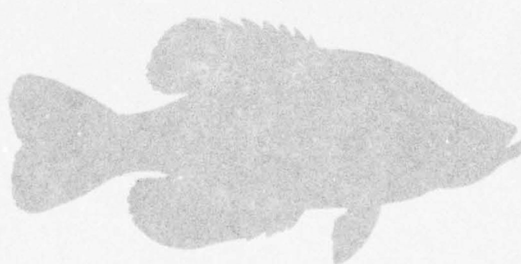


Table II-23

*Minimum flows for fish life recommended to Oregon State Water Resources Board by Oregon State Game Commission (cfs) 1/*

| Stream | Location | Dec.-May | June | July | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|
| Long Tom River | River Mile 50 | 25 | 12 8 | 4 | 4 | 4 | 4 | 15 25 |
| " " " | USGS Gage 14-1665 | 75 | 40 25 | 15 10 | 10 | 10 | 10 | 50 75 |
| " " " | USGS Gage 14-1690 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| " " " | USGS Gage 14-1700 2/ | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| Bear Creek | 1 mile upstream from mouth | 8 | 3 1 | 0.5 | 0.5 | 0.5 | 0.5 | 6 8 |
| Ferguson Creek | 3 miles upstream from mouth | 20 | 5 3 | 2 1 | 0.5 | 0.5 | 0.5 | 12 20 |
| Noti Creek | Just upstream from Poodle Cr. | 12 | 4 2 | 2.0 1 | 1 | 1 | 1 | 8 12 |
| Poodle Creek | Just upstream from Noti Cr. | 30 | 12 8 | 4 3.0 | 2 | 2 | 2 | 15 30 |

1/ *Where 2 figures are shown, minimums change during the month.*
2/ *From listed gage to mouth of listed stream.*

Table II-24

*Numbers of fish stocked in Long Tom Subbasin, 1961-1965*

| Stream system or lake | Species | Mean Length (Inches) | Number per pound | 1961 | 1962 | 1963 | 1964 | 1965 | Agency |
|---|---|---|---|---|---|---|---|---|---|
| Long Tom River | Rainbow | 8 & over | - | 4,000 | 4,000 | 3,900 | | | OSGC |
| Fern Ridge Reservoir | Rainbow | 8 & over | - | 5,300 | 5,000 | 5,000 | | | OSGC |
| Fern Ridge Borrow Pit | Rainbow | 8 & over | - | | | | 6,000 | 7,100 | OSGC |

## SUBBASIN 5 - SANTIAM

Santiam and Calapooia Rivers (Map II-5) are the major streams of this subbasin. Nonstream waters with managed fish populations include approximately 125 Cascade mountain lakes, a few lowland lakes, Detroit and Big Cliff Reservoirs on the North Santiam River, and Foster and Green Peter Reservoirs in the South Santiam River drainage.

### Habitat

North Santiam River, 92 miles long, and South Santiam River, 66 miles long, join to form Santiam River near the town of Jefferson. Santiam River, 11 miles long, enters Willamette River from the east at river mile 109 between Salem and Albany. The entire Santiam River watershed covers 1,827 square miles (Map II-5).

Both forks of the Santiam drain forested watersheds extending to the Cascade Range summit. Without flow diversion or regulation, summer stream discharge would rarely drop below 500 cfs at the mouth of the North Santiam, or below 150 cfs at the mouth of the South Santiam. Substantial amounts of water are diverted from each stream for municipal, industrial, power generation, and agricultural purposes. Release of water from Detroit Reservoir in the low-flow periods, however, normally compensates for the North Santiam diversion losses. Green Peter and Foster Reservoirs supplement summer flows in the South Santiam.

Calapooia River, 75 miles in length, drains 372 square miles and joins Willamette River from the east at Albany. The upper river drains Cascade Range foothills. Near the community of Holley, at river mile 45, the gradient begins to flatten as the river approaches the Willamette Valley floor. Below Brownsville, at river mile 33, the gradient is nearly flat, and the river meanders through agricultural land. River discharge in the summer is seldom less than 25 cfs either at Holley or at the mouth, but owing to numerous irrigation withdrawals, summer flow commonly falls below this volume in sections of the river downstream from Holley. Since 1940 the lowest instantaneous flow recorded by a U. S. Geological Survey gage near the river mouth was 4 cfs.

Streamflow quantities and qualities are usually favorable for salmonids except in lower areas of the subbasin where the gradient is nearly flat. Even in these areas, habitat appears to be generally favorable for fall chinook production. In the summer and early fall, flows in the lower portions of Calapooia and South Santiam Rivers and their tributaries are too low for successful salmonid rearing. Diversion from these two rivers aggravates the problem. Water temperatures of the Calapooia below Holley and the South Santiam below Waterloo commonly exceed 75°F and occasionally rise above 80°F in summer months. Paper mill wastes introduced at Lebanon further limit the use of the South Santiam by trout and salmon. Releases of water with temperatures generally less than 55°F from Detroit and Big Cliff Reservoirs contribute to the favorable salmonid environment in lower North Santiam River.

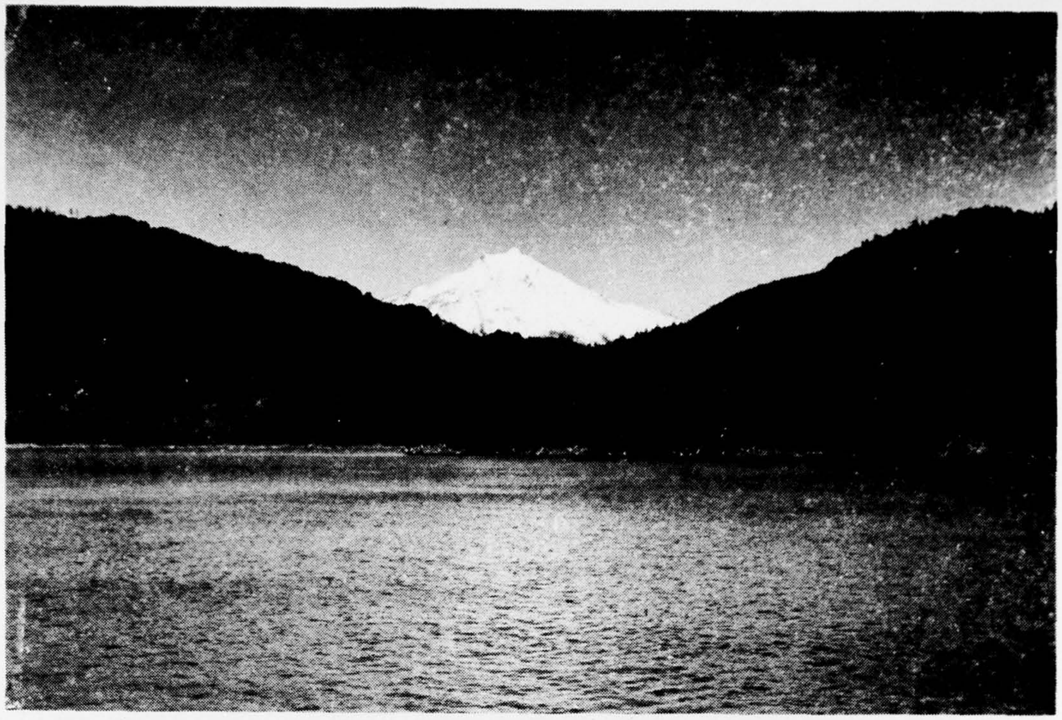


*Photo II-25. Detroit Reservoir is a favorite spot for fishermen. (Oregon State Highway Department photo)*

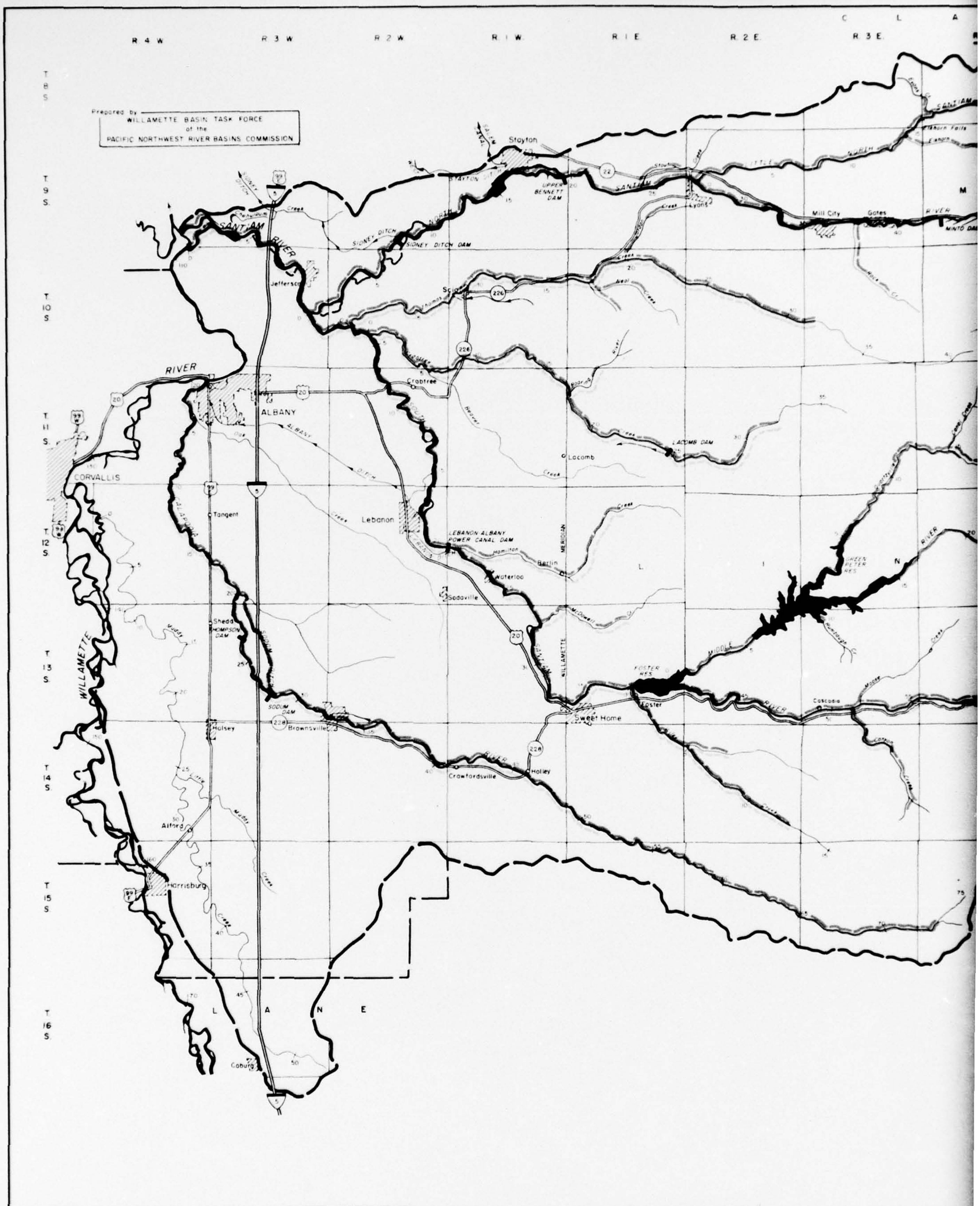
About 125 Cascade lakes provide excellent trout habitat. Marion Lake, the largest, covers 325 acres and is 180 feet deep.

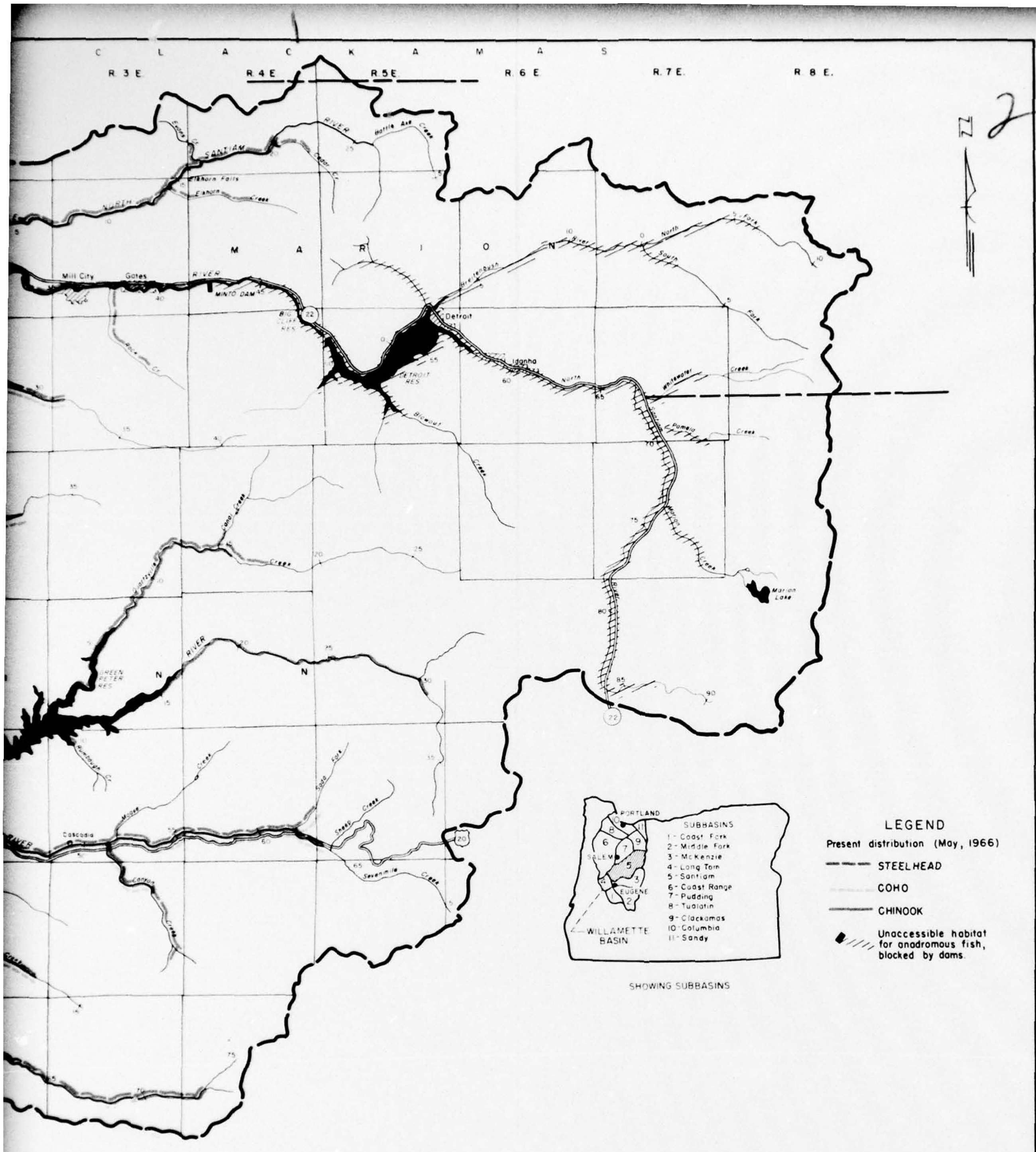
Detroit Reservoir, a 3,580 surface-acre impoundment on the North Santiam River at mile 49.2, offers extensive habitat for salmonids and is nearly devoid of nongame fish species. The 100 surface-acre Big Cliff Reservoir, located immediately downstream, has habitat of similar quality. Beginning in 1953, Detroit and Big Cliff Dams, since they have no fishways, closed over 84 miles of spawning and rearing area to large runs of steelhead trout and spring chinook salmon.

Foster and Green Peter Dams, which were recently completed on South and Middle Santiam Rivers, furnish nearly 5,000 acres of reservoir that may prove to be good salmonid habitat. There is, however, danger that nongame fish may become a problem in these reservoirs, thus reducing their value to cold-water species.

## Species and Distribution

Santiam Subbasin streams support annual spawning escapements averaging 8,700 winter steelhead trout and 9,900 spring chinook salmon. The distribution of winter steelhead and spring chinook is shown in Map II-5. Fall chinook salmon have been stocked in the watershed in recent years, but it is too early to evaluate the return of adults. In the 1965-1966 spawning season, a few adult coho returned to Hamilton Creek, tributary to South Santiam River. This was the first observed result of attempts to establish runs of coho salmon in the subbasin.


Prepared by
WILLAMETTE BASIN TASK FORCE
of the
PACIFIC NORTHWEST RIVER BASINS COMMISSION
R.4 W.
R.3 W.
R.2 W.
R.1 W.
R.1 E.
R.2 E.
R.3 E.
T. 8 S.
T. 9 S.
T. 10 S.
T. 11 S.
T. 12 S.
T. 13 S.
T. 14 S.
T. 15 S.
T. 16 S.
Stayton
UPPER BENNETT DAM
SIDNEY DITCH
SIDNEY DITCH DAM
SANTIAM
RIVER
Jefferson
Scio
Lyons
Mill City
Gates
MINTO DAM
Crabtree
ALBANY
ALBANY DITCH
CORVALLIS
Lacomb
LACOMB DAM
Tangent
Lebanon
LEBANON ALBANY POWER CANAL DAM
Hamilton
Berlin
MERIDIAN
Waterloo
Sodaville
GREEN PETER RES.
Shedd
THOMPSON DAM
WILLAMETTE
FOSTER RES.
Foster
Sweet Home
Cascadia
SODOM DAM
Halsey
Brownsville
Crawfordsville
Holley
Alford
Harrisburg
Coburg
L A N E
L I N N




MAP II - 5
SANTIAM SUBBASIN
WILLAMETTE BASIN, OREGON

ANADROMOUS FISH DISTRIBUTION

APRIL 1967

3 0 3 6
SCALE IN MILES

WBTF-5-1167d-LL

Of the total number of winter steelhead spawning each year in the subbasin, approximately 4,100 enter South Santiam River, 3,500 North Santiam River and 1,000 Calapooia River. The number of steelhead trapped below Big Cliff Dam and artificially spawned is included in the North Santiam total. The trap is at Minto Dam, a low structure in North Santiam River 2.8 miles downstream from Big Cliff Dam. The dam and trap were built specifically for anadromous fish collection and egg-taking purposes. The numbers of steelhead and spring chinook entering the Minto trap since its installation in 1952 are listed in Table II-25.

Table II-25

*Adult anadromous fish counts, Santiam Subbasin, 1952-1965*

| | Minto Dam Trap North Santiam River 2/ | | Elkhorn Falls Electronic Counter Little North Santiam River 3/ | |
|---|---|---|---|---|
| Year 1/ | Spring Chinook | Winter Steelhead | Spring Chinook | Winter Steelhead |
| 1952 | 906 | 1,635 | | |
| 1953 | 1,744 | 1,339 | | |
| 1954 | 1,334 | 1,108 | | |
| 1955 | 770 | 902 | | |
| 1956 | 843 | 1,073 | | |
| 1957 | 2,214 | 991 | | |
| 1958 | 2,181 | 794 | | |
| 1959 | 1,586 | 207 | 225 | 6 |
| 1960 | 932 | 229 | 395 | 28 |
| 1961 | 689 | 181 | 328 | 21 |
| 1962 | 1,316 | 512 | 286 | 514 |
| 1963 | 2,983 | 172 | No count | 78 |
| 1964 | 2,580 | 848 | 438 | 76 |
| 1965 | 1,918 | 1,661 | No count | No count |

*1/ Runs are listed in the year they terminate.*

*Source: 2/ Fish Commission of Oregon*
*3/ U. S. Fish and Wildlife Service*

Table II-25 also includes adult steelhead enumerated by an electronic fish counter in the ladder ascending Elkhorn Falls. The falls is situated at river mile 16 on Little North Santiam River, a tributary of North Santiam River. About 20 percent of the steelhead in the Little North Santiam system spawn above Elkhorn Falls.

About 6,100 and 3,700 spring chinook spawn annually in the North and South Santiam drainages, respectively. The North Santiam total includes the number of spring chinook trapped at Minto Dam. The subbasin's remaining spring chinook, averaging about 100 adults, enter Calapooia River. About 43 percent of the spring chinook run of Little North Santiam spawn above Elkhorn Falls. Most of the spring chinook in the South Santiam River drainage spawn in South Santiam's largest tributary, Middle Santiam River.

Resident cutthroat trout are common in lower portions of the watershed and are usually plentiful in higher elevation streams. Populations of wild rainbow trout are normally smaller than cutthroat populations but are similarly distributed. Whitefish are numerous in larger, higher elevation streams. Planted rainbow and brook trout constitute the bulk of the trout in the Cascade lakes. Native cutthroat and exotic golden trout also inhabit a few of these lakes. Stocked rainbow trout and kokanee salmon are the prevalent fish in Detroit Reservoir.

Most of the stream habitat for warm-water game fish is in the lower Calapooia River. Largemouth bass, bullhead catfish and probably a few other species exist there in moderate numbers. Several small lowland lakes and ponds, not associated with Willamette River, also contain warm-water game fish. The names and locations of most of these waters are listed in Table II-26.

Table II-26
*Low elevation lakes and ponds providing public angling for warm-water game fish in Santiam Subbasin 1/*

| Water | Total Surface Acres | Location |
|---|---|---|
| Talbot Lake | 30 | One-half mile east of Talbot and 3 miles northeast of Santiam and Willamette River confluence. |
| Meridian Lake | 20 | Two miles north of Jefferson on south side of Talbot Road. |
| Jefferson Borrow Pit | 2 | Just off west side of Interstate 5 at the northern Jefferson junction. |
| Waverly Lake | 5 | At northern edge of Albany city limits. Juvenile anglers only. |
| Timber-Linn Lake | 5 | One-half mile northeast of Albany in Timber-Linn Park and east of the Albany airport. |
| Oak Creek Borrow Pits | 10 | One pit on either side of Interstate 5, 3 miles south of Albany. |

1/ *Predominant game fish species in these waters are white crappie, black crappie, bluegill, largemouth bass, warmouth bass and brown bullhead.*

Dace and sculpins are common throughout most streams and are the only nongame fish known to inhabit the North Santiam River system above Detroit Dam. Cool water from Big Cliff and Detroit Reservoirs limits the population of redside shiners, largescale suckers, and squawfish in lower North Santiam River, but these fish are numerous in the lower portions of the Calapooia and South Santiam systems.

Developments and Conditions Adversely Affecting Fish Resources

Detroit Dam, 382 feet high, was constructed by the U. S. Army Corps of Engineers on North Santiam River. The dam and its re-regulating structure, Big Cliff Dam, 122 feet high, are unladdered and have completely blocked anadromous fish since 1953. Prior to that date, large runs of steelhead and spring chinook spawned above the site. Because anadromous fish were to be blocked by the dams, mitigation was provided by artificial propagation at Marion Forks Hatchery. To date this mitigative effort, coupled with natural reproduction in the river below Minto, has maintained steelhead and spring chinook runs, although numbers are below the stream potential (Table II-25).

In 1967, the U. S. Army Corps of Engineers completed construction of Foster Dam at river mile 37.7 on South Santiam River and at Green Peter Dam 7.5 miles farther upstream on Middle Santiam River. Foster Dam is 131 feet high and impounds a 1,220 surface acre reservoir. Green Peter Dam is 327 feet high and has a 3,720-acre reservoir. Green Peter and Foster Reservoirs are used for flood control and to store water for irrigation, navigation, and power generation. Foster Reservoir also regulates fluctuating power releases from Green Peter Reservoir. Fish passage facilities are incorporated into both dams. Most of the South Santiam River's steelhead and spring chinook spawn above Foster Dam.

Foster and Green Peter Reservoirs inundate about 22 miles of good anadromous fish habitat, approximately 19 percent of the total above the Foster damsite. There is danger that suckers and squawfish will over-populate the reservoirs to the detriment of salmonids, as occurred in Lookout Point and Dexter Reservoirs on Middle Fork Willamette River. As in the case of the latter reservoirs, suckers and squawfish in Foster and Green Peter Reservoirs could spread to upper stream areas formerly free of these species. The stream system above Foster Dam was treated prior to impoundment in an attempt to eradicate rough fish and avoid these undesirable situations.

The status of fish passage facilities at other dams in the subbasin is summarized in Table II-27.

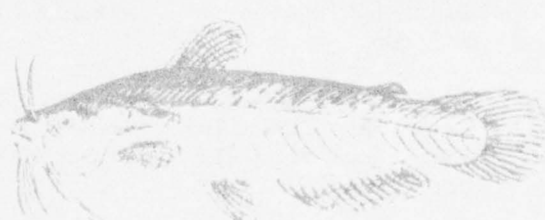


Table II-27
*Major falls, dams and diversions affecting anadromous fish, Santiam Subbasin*

| Stream | Location and Name of Falls or Dam | Description 1/ |
|---|---|---|
| Calapooia River | Thompson Dam. River mile 23.5 | Concrete dam 5 feet high. Passable but inadequate ladder. Diverts flows into unscreened Thompson Ditch for a flour mill. |
| Sodom Ditch | Headgate near Calapooia River at mile 28.3 | Concrete dam 8 feet high. Sodom Ditch acts as an overflow river channel. Fish ladder is passable but inadequate. |
| North Santiam River | River mile 8.0 Sidney Ditch Dam | Low gravel wing dam diverts into unscreened Sidney Ditch for irrigation. |
| North Santiam River | River mile 17.9 Lower Bennett Dam; in river's north channel around Stayton Island | Wooden dam 5 feet high. Passable but inadequate ladder is being replaced. Diverts flows into unscreened Stayton Power Canal. An unscreened irrigation ditch diverts from the canal. |
| North Santiam River | River mile 19.7. Upper Bennett Dam; in river's south channel around Stayton Island | Wooden dam 5 feet high. Passable but inadequate ladder is being replaced. Assists in diverting to Stayton Power Canal and Salem Power Canal, both unscreened. |
| North Santiam River | River mile 18.0. Salem Power Canal Dam (Salem Ditch) | A wing dam (Salem Power Canal Dam) and Lower Bennett Dam immediately downstream divert flows into Salem Power Canal. |
| Stayton Power Canal | Pacific Power and Light Co. Dam in Stayton | Concrete dam. Passable but inadequate ladder. |
| North Santiam River | River mile 43.5. Minto Dam; 2.8 miles downstream from Big Cliff Dam | Concrete unladdered dam 10 feet high. Diverts anadromous fish adults into Minto trap facility. |
| North Santiam River | River mile 46.4. Big Cliff Dam | Concrete dam, 122 feet high. Re-regulating structure. No fish passage facilities. |

Table II-27 (Cont'd)

| Stream | Location and Name of Falls or Dam | Description 1/ |
|---|---|---|
| North Santiam River | River mile 49.2 Detroit Dam | Concrete Dam, 383 feet high. Multi-purpose structure. No fish passage facilities. |
| Little North Santiam River | River mile 16.0 Elkhorn (Salmon) Falls | Rock falls 25 feet high. Adequate concrete ladder. |
| South Santiam River | River mile 20.8. Lebanon-Albany Power Canal Dam. | Concrete dam 9 feet high. Three passable ladders. Diverts flows into unscreened Lebanon Ditch for various uses. |
| South Santiam River | River mile 37.7. Foster Dam | Rock fill dam 131 feet high. Fish passage facilities provided. |
| Middle Santiam River | River mile 5.7. Green Peter Dam | Concrete dam 277 feet high. Fish passage facilities provided. |
| Crabtree Creek | River mile 24.7. Lacomb Dam | Low gravel dam diverts flows for irrigation into unscreened Lacomb Ditch. |
| Thomas Creek | River mile 31.5 | Fifty-foot unladdered rock falls. Blocks spring chinook and steelhead. |
| Wiley Creek | River mile 0.3 | Concrete dam 30 feet high. Passable ladder which often clogs with debris. (Photo II-27) |

*1/ Status as of July 1966 (excluding Foster and Green Peter Dams.)*

Upstream fish passage is seriously impeded at the dam on Sodom Ditch (Figure II-2) and Upper Bennett Dam on North Santiam River (Figure II-3).

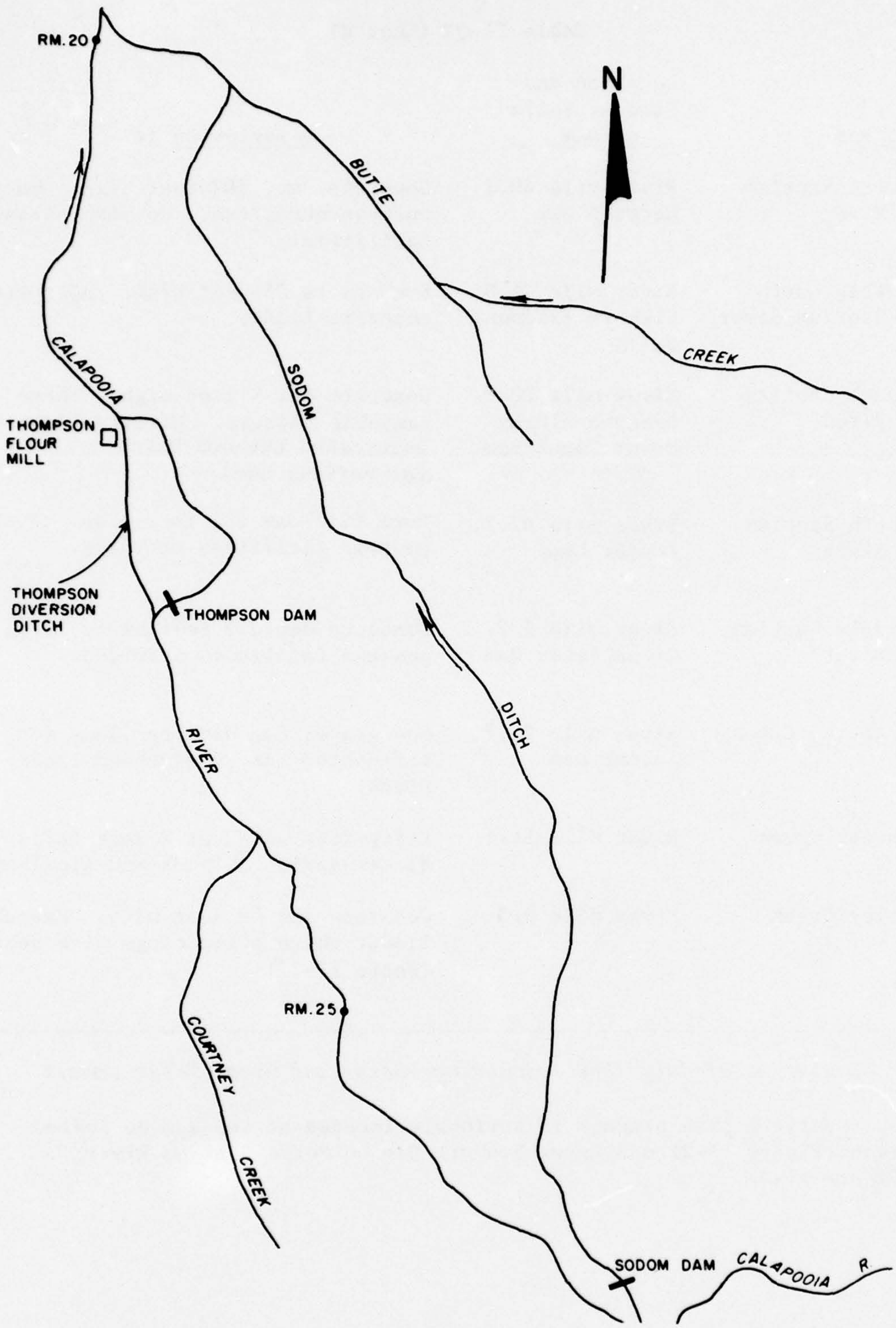



*Figure II-2. Sketch of Sodom diversion area.*

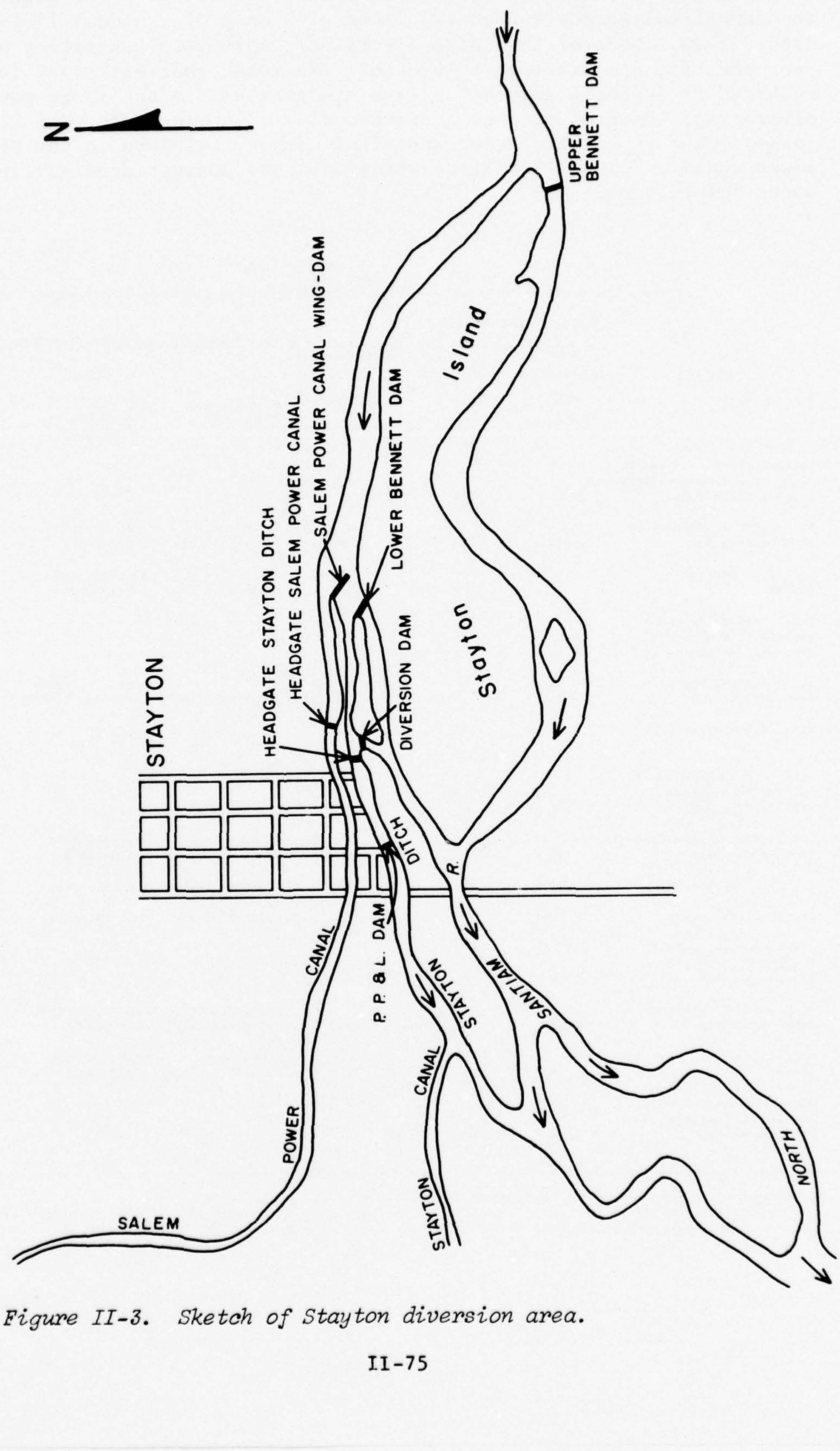



*Figure II-3. Sketch of Stayton diversion area.*

Ditches or canals diverting water for irrigation, power generation, and industrial purposes are associated with many of the dams listed in Table II-27. None of the large diversions, some with capacities of over 200 cfs, are screened to prevent fish loss. Mortality and injury incurred by juvenile anadromous fish are greatest in the large power diversions. Studies of the unscreened diversions indicate that heaviest losses occur at Pacific Power and Light Company turbines in the Stayton power canal. Table II-28 lists streamflow and appropriated surface water information.

**Table II-28**

*Appropriated surface water and minimum streamflow measurement data Santiam Subbasin (cfs)*

| | Appropriated Surface Water 1/ | | Instantaneous Minimum Flows Measured | | | |
|---|---|---|---|---|---|---|
| Stream Area | Non-Consumptive | Consumptive | Instantaneous Discharge | Location | Date 2/ | Source 2/ |
| Santiam River | 0.0 | 4.9 | 260 | At Jefferson River mile 9.6 | Aug. 15-22, Aug. 24-Sept. 2, 1940 (1939-1967) | USGS |
| Tributaries to Santiam R. downstream from & excluding North & South Forks | 0.0 | 2.3 | - | - | - | - |
| N. Santiam R. downstream from Detroit Dam | 1,471 | 940 | 256 | At Mehama, River mile 38.7 | July 19, 1965 (1921-1967) | USGS |
| Little N. Santiam System | 63 | 2.6 | 13 | River mile 2.0 | Aug. 30, 1961 (1931-1967) | USGS |
| Other tributaries to N. Santiam R. downstream from Detroit Dam | 16 | 53 | - | - | - | - |
| N. Santiam R. upstream from Detroit Dam | 0.0 | 6 | 250 | River mile 70.7 | Sept. 13, 1909 (1907-09) (1928-65) | USGS |
| Breitenbush R. System | 70 | 0.7 | 87 | River mile 2.0 | Sept. 2, 1940 (1932-1967) | USGS |
| Other tributaries to N. Santiam R. upstream from Detroit Dam | 75 | 11 | - | - | - | - |
| S. Santiam R. downstream from Foster Dam | 50 | 22 | 61 | At Waterloo, River mile 23.3 | Oct. 12, 1967 (1923-1967) | USGS |
| Crabtree Creek System | 17 | 82 | 18 | River mile 1.6 | Aug. 30, 1962 | OSGC |
| Thomas Creek System | 19 | 79 | 9.7 | River mile 4.7 | Aug. 25, 1961 | OSGC |
| Other tributaries to S. Santiam R. downstream from Foster Dam | 16 | 26 | - | - | - | - |
| S. Santiam R. upstream from Foster Dam | 0.0 | 11 | 23 | Near Cascadia, River mile 48.5 | Dec. 1, 2, 1936 (1935-1967) | USGS |
| Middle Santiam River | 6 | 2.8 | 66 | Near Foster River mile 0.7 | Sept. 10, 1966 (1950-1967) | USGS |
| Other tributaries to S. Santiam R. upstream from Foster Dam | 14 | 1.1 | - | - | - | - |

*1/ Oregon State Water Resources Board records, April 1966.*
*2/ U. S. Geological Survey periods of available records are shown in parenthesis. Oregon State Game Commission listings are the lowest of flows measured monthly in low-discharge periods of 1961 and 1962.*

Several factors limiting fish production in the subbasin are not entirely man-caused. Seasonally, low warm flows in low elevation streams impair rearing of anadromous fish. Large populations of nongame fish in lower Calapooia and South Santiam River systems compete with game fish for food and living space. At least 25 falls and cascades in the Santiam River system are believed to warrant study of passage feasibility at the present stage of demand for fish and fishing area.

*Photo II-26. Log pond dam with inadequate fish ladder on Ames Creek. (Oregon State Game Commission photo)*

*Photo II-27. Debris jams, such as this one at a dam on Wiley Creek, can limit or eliminate fish access to spawning area. (Oregon State Game Commission photo)*

*Photo II-28. Fishway cut in bedrock on Wiley Creek. (Bureau of Commercial Fisheries photo)*

## Developments Beneficial to Fish Resources

Fish passage facilities at falls were described in Table II-27. Occasionally log jams are removed and low falls or cascades are altered to improve adult anadromous fish passage.

Detroit Reservoir receives heavy use from trout fishermen and other recreationists, and provides flow releases for fish life downstream. To this extent the reservoir can be considered beneficial. Studies to determine the impact of Foster and Green Peter Reservoirs on fish and fishing are in progress. Since mitigative features have been incorporated into the projects there is reason for hope that project effects will be beneficial.

Three fish hatcheries are located in the subbasin. Marion Forks Hatchery near river mile 73 on North Santiam River is operated by the Fish Commission of Oregon. This installation, provided by the Corps of Engineers as mitigation for Detroit and Big Cliff Dams, rears spring chinook and steelhead from eggs of fish trapped at Minto Dam. Another Fish Commission salmon hatchery on Middle Santiam River was recently relocated downstream to avoid inundation by Foster Reservoir. Oregon State Game Commission owns and operates a trout hatchery on Roaring River, a tributary to Crabtree Creek.

The subbasin contains 17 private stocked fish ponds and two private hatcheries. These are not open to the public except for a few where fishing is allowed on a fee basis.

Oregon State Game Commission's Roaring River Hatchery produces many of the rainbow trout stocked in Willamette Basin streams. Trout and anadromous fish stocked in Santiam Subbasin waters in the 1961-1965 period are listed in Table II-29. Summer steelhead introductions were initiated in the Little North Santiam in 1966.

Table II-29

*Numbers of fish stocked in Santiam Subbasin, 1961-1965*

| Stream system or lake | Species | Mean Length (Inches) | Number per pound | 1961 | 1962 | 1963 | 1964 | 1965 | Agency |
|---|---|---|---|---|---|---|---|---|---|
| North Santiam | Fall Chinook | - | 1,044 | | | | | 860,800 | FCO |
| " " | Spring Chinook | - | 23-60 | 1,810,800 | 1,606,800 | 1,503,300 | 1,225,900 | 1,942,800 | " |
| " " | " | - | 1,264 | | | | 1,677,400 | 345,300 | " |
| " " | Coho | - | 1,162 | | 194,100 | | | | " |
| " " | Steelhead | - | 7.6-17 | | 72,000 | 315,300 | 164,600 | 150,900 | " |
| " " | " | - | 24-46 | 551,200 | | | | | " |
| " " | " | - | 28 | | 194,900 | 125,900 | | 30,000 | USFWS |
| " " | " | - | 63-95 | | 699,100 | | 42,000 | | FCO |
| " " | " | - | 291 | | 212,800 | | | | " |
| " " | " | - | 2,746 | | | | | 112,200 | " |
| " " | Rainbow | 8 & over | - | 121,900 | 116,600 | 113,900 | 114,500 | 58,100 | OSGC |
| South Santiam | Fall Chinook | - | 1,150 | | | | | 800,000 | FCO |
| " " | Spring Chinook | - | 15-27 | 273,100 | 154,100 | 157,900 | 147,800 | | " |
| " " | " | - | 139 | | | | 58,400 | | " |
| " " | " | 2-4 | - | | | | | 398,400 | " |
| " " | Coho | - | 17 | | | | | 69,000 | " |
| " " | " | - | 57-P0 | | | | | 370,500 | " |
| " " | " | - | 102-302 | 100,900 | | | | 50,400 | " |
| " " | " | - | 1100-1210 | | | 850,000 | | 697,000 | " |
| " " | Steelhead | 2-4 | - | | | | | 8,000 | OSGC |
| " " | " | 4-6 | - | | | | | 17,000 | " |
| " " | Rainbow | 8 & over | - | 28,900 | 36,900 | 33,600 | 35,000 | 38,100 | " |
| Calapooia | Coho | - | 1100-1250 | | 280,000 | 502,400 | | 494,700 | FCO |
| " | Rainbow | 8 & over | - | 12,000 | 12,000 | 12,100 | 12,000 | 12,000 | OSGC |
| Fay Lake | Brook trout | 2-4 | - | 1,100 | | | 900 | 2,100 | " |
| " " | Golden trout | " | - | | | | 2,000 | | " |
| " " | Rainbow | " | - | 1,200 | 1,100 | 1,200 | 1,600 | 3,200 | " |
| " " | " | 8 & over | - | | | | 1,000 | | " |
| Lost Lake | Brook trout | 2-4 | - | 26,100 | 20,100 | 10,000 | | | OSGC |
| " " | Cutthroat | 2-4 | - | | | | | 7,300 | " |
| " " | Rainbow | " | - | | 20,000 | | | 33,600 | " |
| " " | " | 4-6 | - | 20,000 | | 30,000 | | | " |
| Marion Lake | " | 2-4 | - | 30,400 | 27,800 | 27,900 | 29,500 | 29,400 | " |
| Other Cascade Lakes | Brook trout | 2-4 | - | 49,300 | 19,000 | 34,700 | 26,300 | 28,300 | " |
| " " | Golden trout | 0-2 | - | | | 400 | | | " |
| " " | " " | 2-4 | - | 600 | | 900 | 8,700 | | " |
| " " | " " | 8 & over | - | 400 | | | | | " |
| " " | Rainbow | 2-4 | - | 43,500 | 30,300 | 25,400 | 15,800 | 12,800 | " |
| " " | " | 4-6 | - | 2,700 | | | | | " |
| " " | " | 8 & over | | 100 | | 2,000 | 2,000 | 2,100 | " |
| Detroit Res. | Kokanee | 0-2 | - | 430,900 | | | | 365,900 | " |
| " " | " | 2-4 | - | | 150,000 | 315,000 | | | " |
| " " | Rainbow | " | - | 399,900 | 593,800 | 599,900 | | 802,800 | " |
| " " | " | 4-6 | - | | | 200,100 | 666,700 | 50,400 | " |
| " " | " | 8 & over | - | 95,600 | 104,200 | 93,200 | 95,000 | 99,600 | " |

Table II-30 lists minimum streamflow stipulations established in the subbasin. Future appropriations may be made only for domestic or livestock uses from natural flows of these stream areas. Additionally, natural flows of major portions of many streams in the upper watershed are protected by the State Water Resources Board from significant future water withdrawals. Waters of all natural lakes above the 2,000-foot level, with the exception of those privately owned, are similarly protected.

Table II-30

*Minimum streamflow stipulations established by the Oregon State Water Resources Board*

| Stream 1/ | Location | Minimum Flows (c.f.s.) 2/ Natural | Storage | Total |
|---|---|---|---|---|
| Santiam River | Mouth | 320 | 1,570 | 1,890 |
| Santiam River | USGS gage 14-1890 at river mile 9.6 | 330 | 1,570 | 1,900 |
| North Santiam River | USGS gage 14-1841 at river mile 14.6 | 430 | 640 | 1,070 |
| North Santiam River | USGS gage 14-1830 at river mile 38.7 | 580 | 640 | 1,220 |
| North Santiam River | USGS gage 14-1815 at river mile 57.3 | 500 | 640 | 1,140 |
| North Santiam River | USGS gage 14-1780 at river mile 70.7 | 345 | - | 345 |
| Little North Santiam R. | USGS gage 14-1825 at river mile 2.0 | 40 | - | 40 |
| South Santiam River | USGS gage 14-1875 at river mile 23.3 | 170 | 930 | 1,100 |
| South Santiam River | USGS gage 14-1850 at river mile 48.5 | 50 | - | 50 |
| Wiley Creek | Mouth | 10 | - | 10 |
| Middle Santiam River | USGS gage 14-1865 at river mile 0.7 | 110 | 260 | 370 |
| Calapooia River | USGS gage 14-1735 at river mile 3.0 | 20 | 340 | 360 |
| Calapooia River | USGS gage 14-1720 at river mile 45.4 | 30 | 340 | 370 |

1/ *Includes all tributaries above the listed locations.*

2/ *"Natural" minimum flow stipulations were set by the Oregon State Water Resources Board. The "storage" volumes are provided in addition whenever possible from U. S. Army Corps of Engineers dams located upstream and operated to provide increased low-water flows for navigation.*

Recommendations for minimum streamflows have been made by the Game Commission and are presented in Table II-31.

Table II-31
*Minimum flows for fish life recommended to Oregon State Water Resources Board by Oregon State Game Commission (cfs) 1/*

| Stream | Location | Dec.-May | June | July | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|
| Calapooya River | Holley R. mi. 45.5 | 140 | 90 70 | 50 35 2/ | 30 25 2/ | 25 160 2/ | 160 | 140 |
| Brush Creek | Mouth | 35 | 5 4 | 3 | 3 | 3 | 10 20 | 35 |
| Santiam River | " | 1,500 | 1,000 | 1,000 | 1,000 | 1,000 1,500 | 1,500 | 1,500 |
| North Santiam R. | " | 1,200 | 800 | 800 | 800 | 800 1,200 | 1,200 | 1,200 |
| L. N. Fk. Santiam R. 3/ | " | 180 | 180 60 | 40 | 40 | 100 180 | 180 | 100 |
| Cedar Cr. | " | 60 | 35 15 | 10 8 | 6 | [illegible] | 15 30 | 60 |
| Elkhorn Cr. | " | 50 | 30 20 | 12 8 | 4 | 4 | 15 30 | 50 |
| Evans Cr. | " | 30 | 15 8 | 5 4 | 3 [illegible] | 2 | 8 15 | 30 |
| Mad Cr. | " | 25 | 10 5 | 3 2 | 2 | 2 | 5 10 | 25 |
| Rock Cr. | " | 50 | 30 12 | 8 6 | 4 [illegible] | 3 | 15 30 | 50 |
| Stout Cr. | " | 20 | 10 6 | 4 3 | 3 | 3 | 6 10 | 20 |
| S. Santiam River | Waterloo, R. mile 23.5 | 500 | 400 | 300 200 2/ | 200 2/ | 200 500 2/ | 500 | 500 |
| " | Cascadia, R. mile 50 | 90 | 80 | 70 60 | 50 | 50 90 | 90 | 90 |
| " | Confl. of Soda Fk. | 70 | 60 | 50 30 | 12 | 12 70 | 70 | 70 |
| Ames Cr. | Mouth | 25 | 15 5 | 3 2 | 2 | 2 | 10 | 25 |
| Canyon Cr. | " | 75 | 75 50 | 25 18 | 12 | 12 | 30 50 | 75 |
| " | 1/2 mi. downstream from Owl Cr. | 65 | 30 20 | 20 12 | 6 | 6 8 | 10 30 | 65 |
| Owl Cr. | Mouth | 40 | 30 12 | 8 4 | 3 | 3 | 10 20 | 40 |
| Boundary Cr. | " | 20 | 15 5 | 2 1 | 1 | 1 | 8 15 | 20 |
| Crabtree Cr. | " | 100 | 50 40 | 35 30 2/ | 25 20 2/ | 20 100 2/ | 100 | 100 |
| " | Confl. of Roaring R. | 90 | 40 30 | 25 20 | 15 12 | 12 110 | 110 | 90 |
| Hamilton Cr. | Mouth | 40 | 15 10 | 8 5 2/ | 3 2/ | 3 2/ | 10 20 | 40 |
| Scott Cr. | Confl. of S. Fk. | 14 | 3 2 | 2 1 | 1 | 1 | 5 10 | 14 |
| S. Fk. Scott Cr. | Mouth | 19 | 6 4 | 4 3 | 2 | 2 | 5 10 | 19 |
| McDowell Cr. | " | 45 | 15 10 | 8 5 2/ | 1/ | 3 2/ | 10 20 | 45 |
| Middle Fk. Santiam R. | " | 150 | 120 | 110 | 110 | 110 150 | 150 | 150 |
| " " " " | Confl. of Bear Cr. | 100 | 70 50 | 30 | 30 | 30 100 | 100 | 100 |
| Bear Cr. | Mouth | 25 | 20 10 | 5 | 5 | 5 | 8 15 | 25 |
| Quartzville Cr. | " | 90 | 40 | 30 | 30 | 30 90 | 90 | 90 |
| " " | Confl. of Canal Cr. | 70 | 60 30 | 15 12 | 12 | 12 20 | 40 | 70 |
| Canal Cr. | Mouth | 60 | 30 20 | 15 10 | 8 6 | 6 | 15 40 | 60 |
| " " | Confl. of Elk Cr. | 30 | 10 7 | 6 5 | 4 | 4 | 10 25 | 30 |
| Elk Cr. | Mouth | 50 | 5 4 | 3 | 2 | 2 | 8 20 | 50 |
| Moose Cr. | " | 18 | 10 7 | 6 4 | 3 | 3 | 6 12 | 18 |
| Rumbaugh Cr. | " | 25 | 3 | 2 | 2 | 2 | 6 15 | 25 |
| Tally Cr. | " | 34 | 12 10 | 8 6 | 4 | 4 | 10 20 | 35 |
| Whitcomb Cr. | " | 55 | 12 9 | 7 5 | 4 | 4 | 15 30 | 55 |
| Moose Cr. | " | 55 | 35 15 | 8 6 | 4 | 4 | 6 8 | 55 |
| Soda Fork | " | 60 | 40 30 | 20 15 | 10 | 10 | 30 60 | 60 |
| Thomas Cr. | " | 100 | 50 40 | 35 30 2/ | 25 20 2/ | 20 2/ 100 | 100 | 100 |
| " " | Jordan. Riv. mi. 19 | 90 | 35 25 | 20 15 | 12 10 | 10 90 | 90 | 90 |
| Indian Prairie Cr. | Mouth | 25 | 15 10 | 6 4 | 3 | 3 | 10 20 | 25 |
| Jordan Cr. | " | 25 | 10 5 | 3 2 | 1 | 1 | 5 15 | 25 |
| Neal Cr. | " | 60 | 20 12 | 10 7 | 6 5 | 5 | 20 40 | 60 |
| Wiley Cr. | " | 100 | 40 25 | 18 15 | 15 2/ | 15 2/ 110 | 110 | 100 |
| L. Wiley Cr. | " | 30 | 15 10 | 8 6 | 4 | 4 | 4 15 | 30 |

*1/ Where 2 figures are shown, minimums change during the month.*
*2/ The recommended summer and early fall flows will not be adequate to correct the existing high temperature problems which limit the productive potentials of the larger streams. The flow figures consider only quantity requirements and were developed in the same manner as those for streams not having such temperature problems.*
*3/ Spawning flow recommendations developed by Fish Commission of Oregon.*

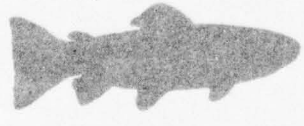
## Present Economy

Each year the subbasin provides an estimated 100 coho, 700 steelhead, and 26,400 spring chinook to the commercial fisheries of Columbia River and Pacific Ocean. This 467,000 pound annual harvest is valued at $254,000.

Approximately 300 steelhead and 400 spring chinook were harvested in 1965 by sport fishermen from the subbasin's streams. The South Santiam above Lebanon and the North Santiam above Stayton furnish the best catches. Little North Santiam, Middle Santiam, and Calapooia Rivers also contribute to the creel. Fishing for both steelhead and spring chinook occurs in spring months and is conducted almost entirely from the bank. Sport fisheries of the subbasin, Pacific Ocean and Columbia and Willamette Rivers, took about 4,300 steelhead, 13,200 spring chinook, and a few coho of Santiam Subbasin origin in 1965. Total angler use of steelhead and salmon produced in the subbasin amounts to an estimated 140,000 angler-days valued at $840,000 annually.

Intensive trout angling takes place in the spring and summer for stocked rainbow trout in larger, higher elevation streams and in Detroit Reservoir. Resident cutthroat in large numbers are caught in upper stream areas. Kokanee provide additional fishing in Detroit Reservoir. Lakes in the Cascade Range support much angling through the summer but are capable of withstanding higher pressure. An estimated 41,000 angler-days valued at $123,000 were spent catching 76,000 trout and whitefish in the streams of the subbasin in 1965. Detroit Reservoir has supported a 4-year average annual catch of an additional 270,000 trout and kokanee in 137,000 angler-days valued at $274,000. Other trout fisheries of considerable magnitude exist on numerous high Cascade lakes. Green Peter and Foster Reservoirs are expected to receive angling pressure similar to that experienced at Detroit Reservoir.

Warm water species, mostly from lower Calapooia River and lakes and ponds listed in Table II-26 furnished an estimated 15,000 fishermen-days valued at $22,000 to the sport fishery in 1965.



## SUBBASIN 6 - COAST RANGE

Marys, Luckiamute, and Yamhill Rivers and Rickreall Creek are the major stream systems in the subbasin (Map II-6). Several small Willamette River tributaries have lesser, yet significant, value for fish.

### Habitat

Major subbasin streams originate in the Coast Range and enter Willamette River from the west (Map II-6). Physical characteristics of the streams closely resemble those found in Tualatin Subbasin to the north and Long Tom Subbasin to the south.

Elevations range from 4,100 feet at the top of Marys Peak to less than 100 feet along Willamette River. Stream gradient is for the most part nearly flat. Warm, low flows in summer and fall severely limit production of salmonids in most streams (Table II-32). Many streams become intermittent or dry.

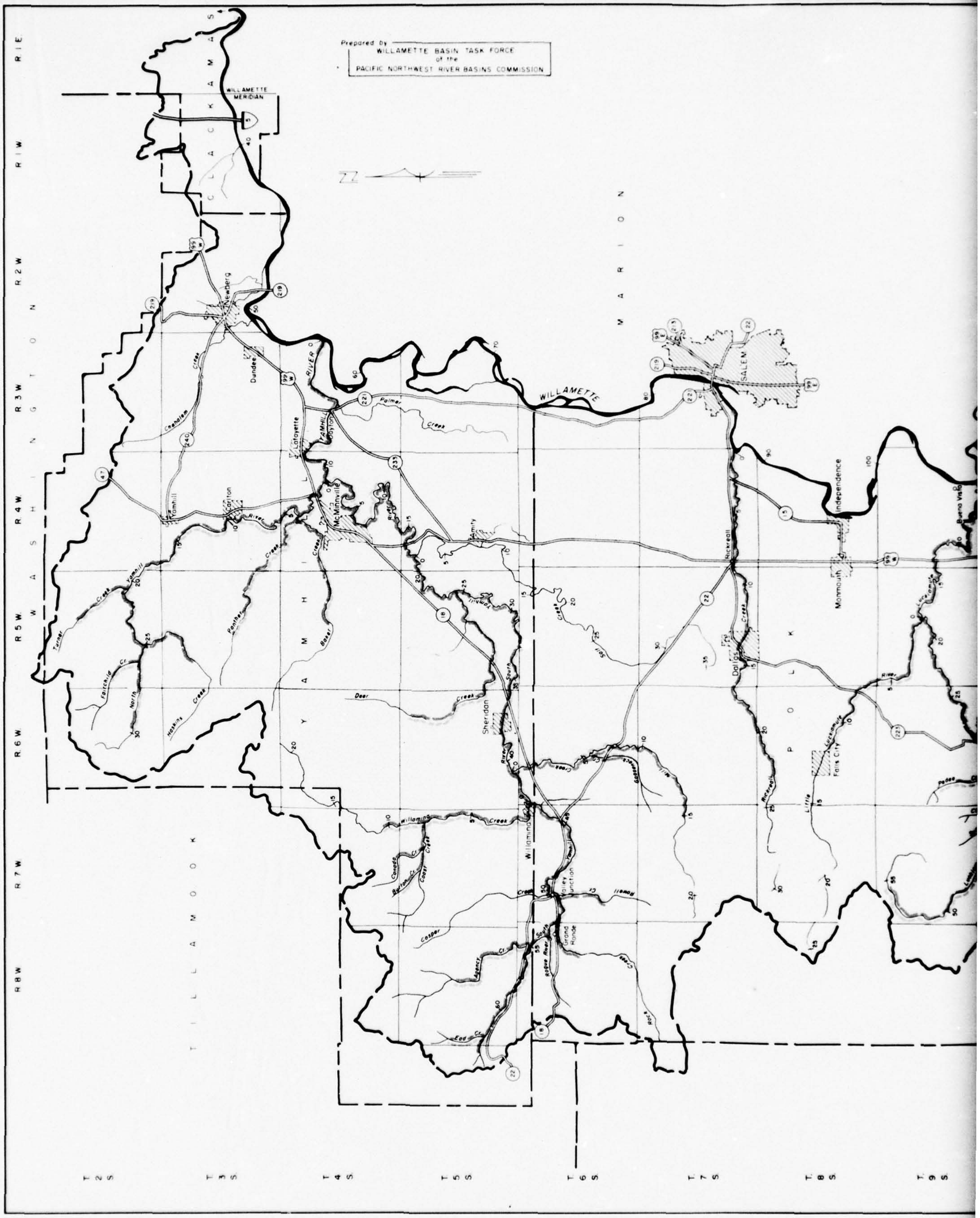
*Photo II-29. Marys River. This dam, an obstacle to fish passage, has been removed. (Oregon State Game Commission photo)*

Table II-32

*Appropriated surface water and minimum streamflow measurement data, Coast Range Subbasin (cfs)*

| Stream Area | Appropriated Surface Water 1/ | | Instantaneous Minimum Flows Measured | | | |
|---|---|---|---|---|---|---|
| | Non-Consumptive | Consumptive | Instantaneous Discharge | Location | Date 2/ | Source |
| Marys River | 64 | 73 | 0.6 | River mile 9.4 | Aug. 23, 1967 (1940-1967) | USGS |
| Luckiamute River | 9.2 | 92 | 0.65 | River mile 13.5 | Aug. 13, 1966 (1940-1967) | USGS |
| Rickreall Creek | 0.6 | 44 | 0.0 | River mile 19.1 | "at times" (1957-1967) | USGS |
| North Yamhill River | 12 | 76 | 4.7 | River mile 20.5 | Aug. 23, 1961 (1948-1967) | USGS |
| South Yamhill River | 0.1 | 159 | 3.2 | River mile 16.7 | Aug. 24, 1967 (1940-1967) | USGS |

1/ *Oregon State Water Resources Board records, April 1966.*
2/ *U. S. Geological Survey periods of available records are shown in parenthesis.*


Prepared by
WILLAMETTE BASIN TASK FORCE
of the
PACIFIC NORTHWEST RIVER BASINS COMMISSION
WILLAMETTE MERIDIAN
CLACKAMAS
WASHINGTON
YAMHILL
TILLAMOOK
MARION
POLK
WILLAMETTE RIVER
SALEM
Newberg
Dundee
Lafayette
Dayton
McMinnville
Yamhill
Carlton
Amity
Sheridan
Willamina
Valley Junction
Grand Ronde
Rickreall
Dallas
Independence
Monmouth
Falls City
Buena Vista
R1E
R1W
R2W
R3W
R4W
R5W
R6W
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R8W
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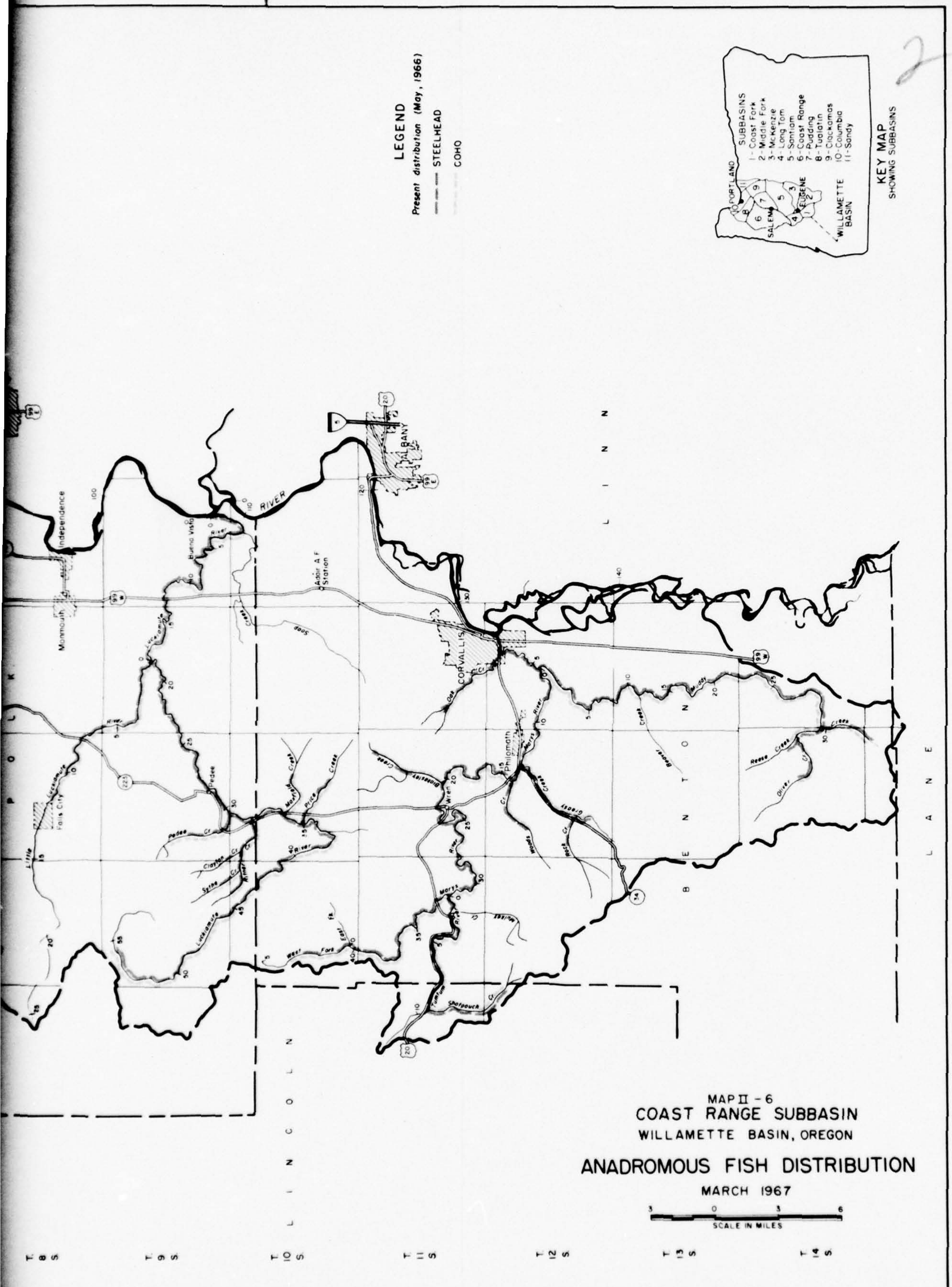



MAP II - 6
COAST RANGE SUBBASIN
WILLAMETTE BASIN, OREGON
ANADROMOUS FISH DISTRIBUTION
MARCH 1967

WBTF-6-1168d-LL

Stream temperatures in summer generally range from 55° to 70°F and occasionally reach 80°F on the Willamette Valley floor. Temperatures of streams on the upper Coast Range slopes are cooler with daily maximums in summer usually below 65°F. Sustained flows of cool water at these higher elevations provide good salmonid habitat.

Natural falls are common in upper portions of several streams. A 20-foot falls at mile 13 on Little Luckiamute is the only one blocking significant potential upstream habitat for anadromous fish. Spawning gravel is adequate in the middle and upper portions of most streams.

## Species and Distribution

In 1965, 5,350 coho salmon entered streams in the Coast Range Subbasin. Of this total, 1,200 entered the Luckiamute, 4,000 the Yamhill, 100 Rickreall Creek, and 50 Marys River. Coho have been introduced into some of these streams only in recent years. In these streams, runs are expected to increase in size for several years. Steelhead have been stocked in the subbasin in recent years, but no established runs are known as yet. Map II-6 illustrates anadromous fish distribution.

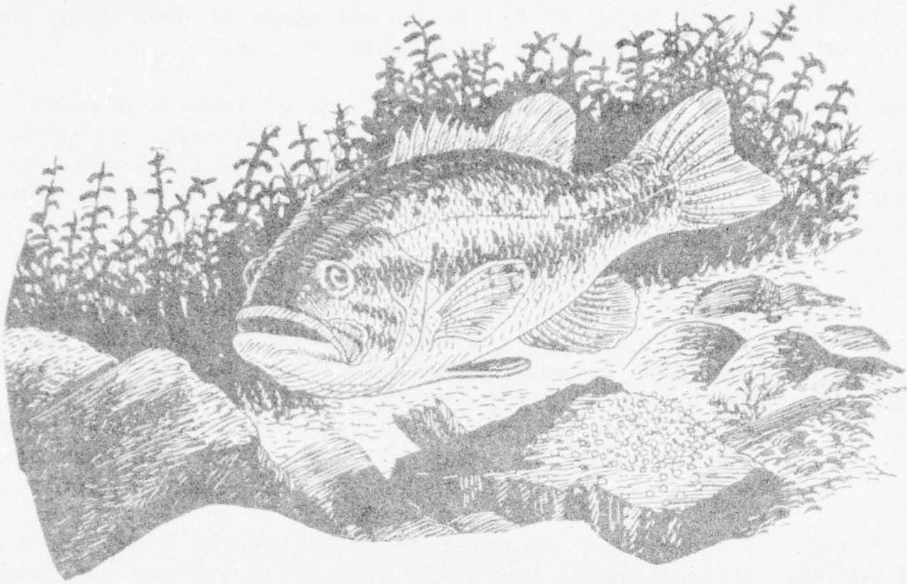
Resident cutthroat trout in moderate to high numbers are scattered throughout most streams having perennial flow, with largest populations occurring in headwater areas.

Substantial numbers of cutthroat from Willamette River enter subbasin streams to spawn in winter and spring. These fish, ranging from 12 to 18 inches in length are of larger average size than cutthroat inhabiting subbasin streams the entire year.

Small numbers of whitefish are indigenous and have distributions similar to cutthroat. Legal-size rainbow trout are stocked annually in larger streams to supplement wild cutthroat stocks. No self-sustaining populations of wild rainbow are found in this subbasin or in other tributaries entering Willamette River from the west.

Warm-water game fish, particularly crappie, largemouth bass, bluegill, pumpkinseed, and bullhead catfish, are common in lower portions of streams near Willamette River. Largest numbers inhabit lower Yamhill River.

Nongame fish are plentiful and are well adapted to the warm water temperatures prevailing in most streams. Numbers of nongame fish increase progressively as the waters of the streams approach Willamette River. Large populations of squawfish, redside shiners, suckers, and several other forms are present in the lower sections of the major streams. The range of suckers extends into the foothills, but numbers dwindle in higher elevation streams until dace and sculpins are the only nongame species.



## Developments and Conditions Adversely Affecting Fish Resources

Low, natural streamflows in summer and fall, which limit production of desirable fish more than any other factor, are further reduced by widespread diversion. The most substantial water diversions are for irrigation, a consumptive use. Table II-32 lists minimum recorded flows and surface water rights for consumptive and nonconsumptive uses.

The Oregon State Water Resources Board estimates that only about one-third of all present water rights in the subbasin are used to their maximum legal extent. This use pattern is partially due to unavailability of water in low flow periods.

Return flows from irrigation and other uses may increase stream temperatures and lower water quality in various ways. Reduced streamflow results in low dissolved oxygen concentrations. Dissolved oxygen concentrations of less than 5 parts per million have been recorded in lower Yamhill River, and they approach this level occasionally in other streams. The major pollution source is the Dallas sewage outfall into Rickreall Creek near mile 13.0. The effluent receives only primary treatment and renders the stream below unfit for salmonids in summer months.

Several dams impede the upstream migration of salmon and trout. Those of primary importance are described in Table II-33. Most of these dams are partial or complete barriers to fish passage.

Table II-33
*Principal dams affecting anadromous fish, Coast Range Subbasin*

| Stream | Dam Location (river mile) | Description |
|---|---|---|
| N. Fk. Rock Creek | Near mouth | City of Corvallis, water supply intake diversion, no ladder. |
| Baker Creek | 9.0 | Concrete water supply dam 15 feet high. Impassable wooden ladder. |
| Panther Creek | 10.0 | Carlton water supply dam, North Yamhill River drainage. |
| Turner Creek | 3.0 | City of Yamhill water supply dam. Concrete, 5 feet high. Fish ladder is passable but inadequate. |
| Rickreall Creek | 24.2 | Earthfill dam 50 feet high. Unladdered. Dallas water supply dam. |

In the Luckiamute River drainage, the only major barrier is the 20-foot high falls at river mile 13 on Little Luckiamute River.

## Developments Beneficial to Fish Resources

Table II-34 lists fish stocked in the 1961-1965 period. Coho salmon stocking was initiated in 1954. Returns of coho have been encouraging particularly in the South Yamhill River tributaries. Except for a liberation in the South Yamhill system in 1958, the first steelhead stocked in the subbasin are those listed in Table II-34.

Table II-34

*Numbers of fish stocked in Coast Range Subbasin, 1961-1965*

| Stream System | Species | Mean Length (Inches) | Number per pound | 1961 | 1962 | 1963 | 1964 | 1965 | Agency |
|---|---|---|---|---|---|---|---|---|---|
| Luckiamute | Coho | - | 1,082-1,162 | | 104,600 | 400,000 | | 392,600 | FCO |
| " | Rainbow | 8 & over | - | 18,000 | 14,100 | 14,000 | 12,000 | 8,900 | OSGC |
| Marys | Coho | - | 1,080-1,100 | | | 350,000 | | 1,178,600 | FCO |
| " | Rainbow | 8 & over | - | 5,000 | 5,000 | 5,000 | 5,000 | 3,900 | OSGC |
| Rickreall Cr. | Coho | - | 1,082 | | | | | 304,900 | FCO |
| " " | Rainbow | 8 & over | - | 3,000 | 3,000 | 3,000 | 3,000 | 2,900 | OSGC |
| Yamhill | Coho | - | 17-66 | 91,800 | 63,200 | 60,400 | 61,800 | 244,000 | FCO |
| " | " | - | 1,082-1,200 | | 598,600 | 754,800 | | 1,827,200 | " |
| " | Steelhead | - | 11 | | | | | 44,000 | " |
| " | " | - | 2,000 | | | | 109,100 | | " |
| " | Cutthroat | 8 & over | - | 2,000 | 2,000 | 2,000 | 2,000 | | OSGC |
| " | Rainbow | " " | - | 20,000 | 19,000 | 17,000 | 14,400 | 19,000 | " |

The Oregon State Water Resources Board has withdrawn waters of a number of streams from further appropriation. A list of the streams thus protected is found in Table II-35. Future appropriations may be made for only domestic or livestock uses from natural flows of these streams. Minimum streamflows recommended by the Game Commission for this subbasin are listed in Table II-36.

Table II-35
*Minimum flow stipulations established by Oregon State Water Resources Board*

| Stream 1/ | Location | Minimum Flows (c.f.s.) |
|---|---|---|
| Marys River | Mouth | 5 |
| Marys River | USGS gage 14-1710 at river mile 9.4 | 10 |
| Luckiamute River | Mouth | 20 |
| Luckiamute River | USGS gage 14-1905 at river mile 13.5 | 25 |
| Luckiamute River | USGS gage 14-1900 at river mile 29.7 | 20 |
| Luckiamute River | USGS gage 14-1895 at river mile 43.2 | 10 |
| Rickreall Creek | USGS gage 14-1907 at river mile 19.1 | 5 |
| Yamhill River | USGS gage at Lafayette | 15 |
| South Yamhill River | USGS gage 14-1940 at river mile 16.7 | 15 |
| South Yamhill River | USGS gage 14-1925 at river mile 45.5 | 20 |
| Willamina Creek | USGS gage 14-1930 at river mile 6.2 | 20 |
| North Yamhill River | USGS gage 14-1970 at river mile 20.5 | 10 |

1/ *Includes tributary systems above the listed locations.*

This subbasin contains 221 private stocked fish ponds and one private hatchery. These are not open to the public except those operated on a fee-fishing basis.

Table II-36
*Minimum flows for fish life recommended to Oregon State Water Resources Board by Oregon State Game Commission (cfs) 1/*

| Stream | Location | Dec.-May | June | July | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|
| Luckiamute River 2/ | Mouth | 200 | 70 50 | 40 30 | 25 2/ | 25 2/ | 25 40 | 80 200 |
| " " | Hoskins R. mi. 38.5 | 120 | 40 30 | 20 15 | 15 | 15 | 15 20 | 50 120 |
| Little Luckiamute R. | River mile 5 | 80 | 50 35 | 25 20 | 15 | 15 | 15 20 | 40 80 |
| Maxfield Creek | Mouth | 12 | 3 1 | 1 | 1 | 1 | 1 2 | 4 12 |
| Pedee Creek | " | 25 | 12 8 | 6 5 | 5 | 5 | 5 10 | 15 25 |
| N. Fk. Pedee Cr. | " | 35 | 20 7 | 5 4 | 4 | 4 | 4 10 | 20 35 |
| S. Fk. Pedee Cr. | " | 6 | 2 1 | 1 | 1 | 1 | 1 2 | 4 6 |
| Price Creek | " | 25 | 4 2 | 1 | 1 | 1 | 1 2 | 5 25 |
| Ritner Creek | " | 45 | 8 6 | 4 3 | 2 | 2 | 2 4 | 8 45 |
| Clayton Cr. | " | 8 | 2 1 | 1 | 1 | 1 | 1 2 | 4 8 |
| Sheythe Cr. | " | 13 | 2 1 | 1 | 1 | 1 | 1 2 | 4 13 |
| Marys River 3/ | " | 135 | 70 40 | 20 15 2/ | 15 2/ | 15 2/ | 20 40 | 70 135 |
| " " | River mile 30 | 75 | 40 15 | 10 6 | 6 2/ | 6 2/ | 8 20 | 40 75 |
| Blakesly Cr. | Mouth | 8 | 2 1 | 1 | 1 | 1 | 1 2 | 4 8 |
| Greasy Cr. | " | 30 | 20 15 | 10 7 | 5 | 5 | 5 10 | 20 30 |
| Rock Cr. | " | 25 | 7 5 | 4 2 | 2 | 2 | 2 4 | 8 25 |
| Oak Creek | " | 10 | 3 2 | 2 | 2 | 2 | 2 4 | 8 10 |
| Tumtum River | " | 30 | 20 15 | 10 6 | 4 | 4 | 6 10 | 15 30 |
| Mulkey Cr. | " | 9 | 4 3 | 2 1 | 1 | 1 | 1 2 | 4 9 |
| Shotpouch Cr. | " | 25 | 8 6 | 5 3 | 2 | 2 | 2 4 | 8 25 |
| W. Fk. Marys R. | River mile 3 | 14 | 5 3 | 3 2 | 2 | 2 | 2 4 | 6 14 |
| Oleman Cr. | Mouth | 18 | 3 1 | 1 1 | 1 | 1 | 1 2 | 4 18 |
| Woods Cr. | " | 15 | 6 4 | 3 2 | 2 | 2 | 2 4 | 8 15 |
| Rickreall Cr. | " | 80 | 18 12 | 8 5 2/ | 5 2/ | 5 2/ | 8 15 | 60 80 |
| Yamhill River | " | 90 | 80 70 | 60 40 | 30 | 30 | 30 60 | 90 |
| North Yamhill R. | Pike Riv. mi. 20.8 | 70 | 40 25 | 15 10 | 10 | 10 | 10 | 70 |
| Baker Cr. | 3 mi. upstream from mouth | 30 | 12 9 | 7 6 | 4 | 4 | 4 6 | 30 |
| Cedar Cr. | Mouth | 12 | 6 4 | 3 2 | 1 | 1 | 4 8 | 12 |
| Fairchild Cr. | " | 25 | 12 9 | 7 6 | 4 3 | 3 | 3 6 | 25 |
| Haskins Cr. | " | 25 | 5 3 | 3 2 | 2 | 2 | 2 3 | 25 |
| Panther Cr. | Just downstream from Kane Cr. | 25 | 6 4 | 4 3 | 3 | 3 | 3 5 | 25 |
| Turner Cr. | Mouth | 25 | 8 6 | 5 3 | 2 | 2 | 2 3 | 25 |
| South Yamhill R. | " | 70 | 70 | 50 40 | 35 2/ | 35 2/ | 40 50 | 70 |
| " " " | Sheridan Riv. mi. 37.5 | 200 | 150 100 | 60 40 2/ | 35 2/ | 35 2/ | 200 4/ | 200 |
| " " " | Just upstream from Willamina Cr. Riv. mi. 43 | 150 | 70 40 | 25 20 | 20 | 20 | 150 | 150 |
| Agency Cr. | Mouth | 80 | 25 20 | 15 10 | 8 6 2/ | 6 2/ | 80 4/ | 80 |
| Wind R. | " | 10 | 6 3 | 1 | 1 | 1 | 3 6 | 10 |
| Casper Cr. | " | 25 | 4 3 | 2 1 | 1 | 1 | 2 4 | 25 |
| Bad Cr. | " | 25 | 5 4 | 3 | 3 | 3 | 3 5 | 25 |
| Gold Cr. | " | 25 | 4 3 | 2 1 | 1 | 1 | 1 2 | 25 |
| Hanchet Cr. | " | 11 | 2 1 | 1 | 1 | 1 | 1 2 | 11 |
| Kitten Cr. | " | 16 | 2 1 | 1 | 1 | 1 | 1 2 | 16 |
| Mill Cr. | " | 80 | 15 10 | 7 5 2/ | 5 2/ | 5 2/ | 80 4/ | 80 |
| Gooseneck Cr. | " | 10 | 5 4 | 2 1 | 1 | 1 | 1 2 | 10 |
| Pierce Cr. | " | 12 | 5 4 | 2 1 | 1 | 1 | 1 2 | 12 |
| Rock Cr. | " | 70 | 30 25 | 20 15 | 10 8 2/ | 8 2/ | 70 4/ | 70 |
| Cow Cr. | " | 10 | 2 1 | 1 | 1 | 1 | 1 2 | 10 |
| Joe Day Cr. | " | 7 | 2 1 | 1 | 1 | 1 | 1 2 | 7 |
| Rogue R. | " | 35 | 10 5 | 4 3 | 2 | 2 | 2 4 | 35 |
| Powell Cr. | " | 45 | 15 8 | 6 5 | 4 | 4 | 4 8 | 45 |
| Willamina Cr. 5/ | " | 70 | 50 30 | 20 20 | 20 | 20 | 20 40 | 70 |
| Coast Cr. | " | 35 | 25 15 | 6 4 | 4 | 4 | 8 25 | 45 |
| Burton Cr. | " | 10 | 8 5 | 2 1 | 1 | 1 | 2 5 | 10 |
| Canada Cr. | " | 20 | 16 8 | 3 2 | 2 | 2 | 3 10 | 20 |
| E. Willamina Cr. | " | 30 | 25 20 | 15 10 | 8 | 8 | 15 20 | 30 |

*1/ Where 2 figures are shown, minimums change during the month.*
*2/ The flow figures consider only quantity requirements and will not be adequate to correct the existing high temperature problems existing in these streams.*
*3/ Minimum spawning flows for coho salmon and steelhead are included where potential exists although the species might not be present.*
*4/ Minimum flows for fall chinook if they become established.*
*5/ Spawning flow recommendations by Fish Commission of Oregon.*

## Present Economy

There is a potential for establishment, or increase, of runs of coho salmon and steelhead trout in streams of Coast Range Subbasin, but runs to date are relatively low. An estimated 12,800 coho produced in this subbasin are harvested annually in the Columbia River and Pacific Ocean commercial fishery. This represents approximately 90,000 pounds of fish valued at $35,000.

Sport angling for anadromous fish is not permitted in the subbasin. This regulation is to protect the relatively low spawning populations. Streams in the subbasin provided an estimated 3,200 coho salmon to sport fisheries of Willamette and Columbia Rivers and the Pacific Ocean in 1965. The 3,200 angler-days expended in this fishery were valued at $19,000.

Trout angling in streams is popular for wild cutthroat and hatchery cutthroat and rainbow. Most fishing is conducted in larger streams in spring and early summer. Stocking is discontinued in summer because of low stream flows and accompanying high water temperature. An estimated 13,000 angler-days valued at $39,000 were expended to catch 28,000 trout from the subbasin's streams in 1965.

There is moderate angling pressure on warm-water game fish in Yamhill River near Lafayette. Species caught most frequently are bullhead catfish, largemouth bass, crappie, bluegill, and yellow perch. This fishery represented an estimated 7,000 angler-days valued at $10,000 in 1965.

## SUBBASIN 7 - PUDDING

Principal streams in Pudding Subbasin are Molalla and Pudding Rivers and Mill Creek, a tributary entering Willamette River at Salem. The primary non-stream areas used by fish are four small lakes in the Cascade Range.

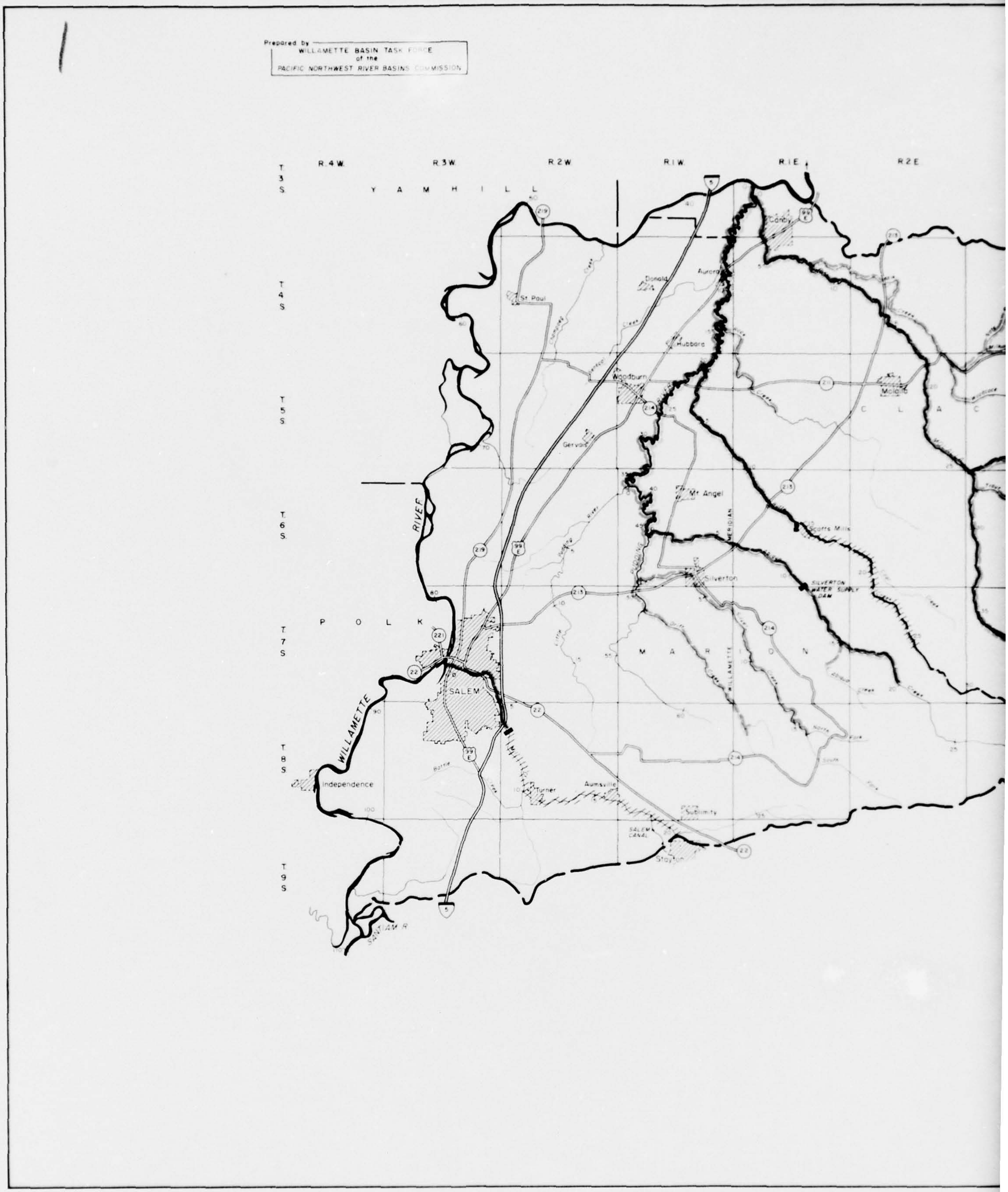
### Habitat

Waters of Molalla River, 49 miles long, and Pudding River, 62 miles long, mingle for only three-quarters of a mile before entering Willamette River 9 miles upstream from Willamette Falls. The Molalla watershed of 348 square miles extends higher into the Cascade Range and receives cooler water than the 530 square mile Pudding River drainage. Pudding River lies entirely on Willamette Valley floor, but its five major tributaries, Abiqua, Butte, Silver, Drift, and Rock Creeks, drain foothills of the Cascade Range (Map II-7).

Both Molalla and Pudding Rivers have average annual discharges of over 1,100 cubic feet per second and are subject to large seasonal variation. Low summer flows, caused partly by diversion for agriculture and other uses, occur in the two rivers and their lower tributaries. Minimum discharge rates recorded since 1928 by U.S. Geological Survey gages in Molalla and Pudding Rivers near their confluence have been 20 and 26 cfs, respectively. However, the Molalla normally maintains somewhat higher and less variable summer flows than Pudding River.

Mill Creek drains 114 square miles and flows 29 miles through mostly low-elevation agricultural land. The Salem Canal diverts water from North Santiam River near Stayton and empties into Mill Creek at stream mile 18.6. The canal normally contributes flows of between 100 and 200 cfs except during high rainfall periods when reductions are necessary to lessen flood danger. The water is used for irrigation and industry, including a few small powerplants. Most of the water use is nonconsumptive, and large flows continue to the creek's confluence with the Willamette. Upstream from the canal, the flow in Mill Creek is normally small and summer flows often become intermittent, partly because of diversions. The importance of Mill Creek for salmonids has been greatly increased by the large amounts of cool water from North Santiam River.

Maximum summer stream temperatures seldom exceed 65° F in upper areas of the subbasin. This is well below the lethal level for salmonids. Pudding River, Molalla River below river mile 25, and low-elevation tributaries of both, however, often have temperatures exceeding 75° F. These temperatures, although not usually lethal for short periods of time, are unfavorable for salmonids. Large numbers of nongame fish compete with salmonids and further reduce production.



Prepared by
WILLAMETTE BASIN TASK FORCE
of the
PACIFIC NORTHWEST RIVER BASINS COMMISSION
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YAMHILL
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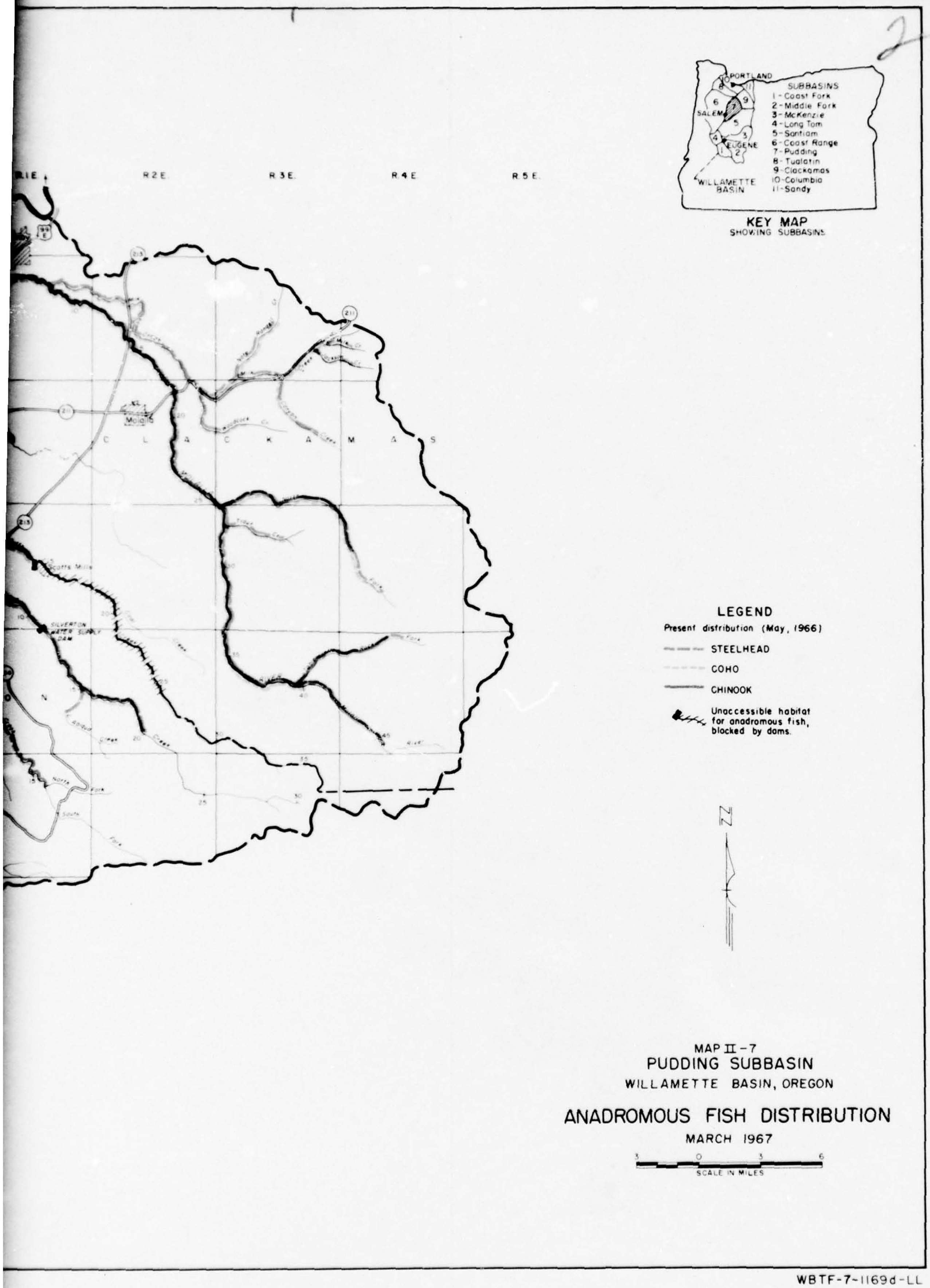
Donald
Aurora
St Paul
Hubbard
Woodburn
Molalla
Gervais
Mt Angel
Scotts Mills
Silverton
SILVERTON WATER SUPPLY DAM
SALEM
Independence
Turner
Aumsville
Sublimity
SALEM CANAL
Stayton




MAP II-7
PUDDING SUBBASIN
WILLAMETTE BASIN, OREGON

ANADROMOUS FISH DISTRIBUTION

MARCH 1967

WBTF-7-1169d-LL

Spawning gravel is plentiful throughout much of the Molalla River system, most Pudding River tributaries, and the entire length of Mill Creek, but is almost nonexistent in Pudding River. Rearing habitat is normally good in higher elevation streams of the subbasin, but is frequently impaired elsewhere by low, warm streamflows in summer and fall. The lower sections of the Molalla and some of the Pudding River tributaries appear to be excellent habitat for fall chinook.

Anadromous fish are barred from several miles of stream habitat by falls. These barriers are briefly described in Table II-37.

The four small mountain lakes furnish good trout habitat.

Table II-37
*Major falls and dams affecting anadromous fish, Pudding Subbasin*

| Stream | Location of Obstruction | Description |
|---|---|---|
| Molalla River | River mile 46.1, 20 yards downstream from Henry Creek. | Falls 35 feet high, impassable. |
| North Fork Molalla River | River mile 4.5, 0.7 mile downstream from Deadhorse Canyon Cr. | Falls 5 feet high. Passage difficult, Several other natural barriers upstream. |
| Butte Creek | River mile 15; at Scotts Mills. | Combination dam and falls 21 feet high. Unladdered and impassable. A 10-foot falls is located 11.5 miles farther upstream. |
| Abiqua Creek | River mile 11, Silverton water supply dam. | Concrete dam 10 feet high with a passable but inadequate ladder. |
| Abiqua Creek | River mile 20, Abiqua Falls. | Falls 100 feet high, impassable. |
| Silver Creek | River mile 3.9 in Silverton. | Concrete dam 5 feet high. Small concrete ladder. |
| North Fork Silver Creek | River mile 0.8. | Several high impassable falls and cascades begin at this point. |
| South Fork Silver Creek | River mile 0.3, Lower South Falls. | Falls 93 feet high. Other impassable falls above. |
| Mill Creek | River mile 2.8, City Ice Works dam. | Concrete dam 6 feet high. Small, concrete ladder. |
| Mill Creek | River mile 3.1, 60 yards south of State Street, Salem. | Concrete dam 6 feet high. New concrete ladder. Diverts water to Boise Cascade Corporation paper mill. |
| Mill Creek | River mile 6.8, upper State Penitentiary dam. | Concrete and board dam 6 feet high. Temporary passage facilities; ladder pending. |
| Mill Creek | River mile 16.5, in Aumsville, Highberger Ditch dam. | Dam 3 feet high. Unladdered but probably passable. Unscreened diversion. |

## Species and Distribution

In 1965, 1,600 coho salmon and 4,500 winter steelhead entered the subbasin. These are believed to approximate the average runs. The 1962 through 1964 average spring chinook salmon run was 500.

Steelhead have a wide distribution (Map II-7). A high percentage of the subbasin's coho spawn in the Milk Creek drainage, tributary to Molalla River at mile 8. Almost all spring chinook spawning is in the Molalla River upstream from mile 25. A few also spawn in the larger tributaries upstream from this point, and in Abiqua Creek, a Pudding River tributary.

Table II-38 lists SCUBA counts of adult spring chinook made in Molalla River pools each summer since 1961. These are not total runs but do reveal population trends. In 1941 a spawning count in only a portion of this area tallied 993 spring chinook, far more than have been known to spawn in recent years.

Table II-38
*Spring chinook salmon counts in selected pools of Molalla River between river miles 27.0 and 46.1 August 1961-65*

| Year | Number of Adults |
|---|---|
| 1961 | 238 |
| 1962 | 245 |
| 1963 | 274 |
| 1964 | 173 |
| 1965 | 95 |

*Source: Oregon State Game Commission.*

Reduction of spring chinook numbers in Abiqua Creek has been more drastic. In 1940 approximately 200 spawning chinook were observed in a 6-mile section. A similar count in 1961 revealed only 8 fish.

Wild cutthroat trout inhabit nearly all streams that maintain perennial flows. Population densities are low to moderate in stream areas on Willamette Valley floor but increase at upper elevations. Wild rainbow trout and whitefish are scattered in limited numbers in upper portions of the watershed. Rainbow and brook trout are found in the Cascade lakes. Rainbow are stocked in the larger streams to supplement wild trout populations for the sport fishery.

Warm-water game fish are restricted mainly to Pudding River and lower portions of its larger tributaries. Populations of largemouth bass and bullhead catfish are substantial owing to the warm, sluggish flows that prevail in the summer.

Several species of nongame fish are abundant throughout lower elevation streams, but their numbers diminish with increases in elevation and decreases in water temperature. Exclusive of dace and sculpins, largescale suckers are the most widely distributed and occasionally are found in some higher elevation streams.

## Developments and Conditions Adversely Affecting Fish Resources

Developments within the subbasin most detrimental to salmonid production are those affecting the quantity and quality of streamflow. Consumptive water use, pollution, gravel mining, logging, and other watershed alterations all contribute to the deterioration of fish habitat. (See Table II-10 and Map II-13 of Appendix G for forest land sediment production rates, and high hazard areas.) Water rights for consumptive use of surface water exist for more than 300 cfs (Table II-39). More than three-fourths of this is for irrigation. Much of it is pumped from Molalla and Pudding Rivers. Simultaneous removal of large volumes of the appropriated water could dry major portions of both stream channels which presently experience critically low summer flows.

*Photo II-30. Three-fourths of the water right for consumptive use of surface water is for irrigation. (Soil Conservation Service photo)*

Table II-39

*Appropriated surface water and minimum streamflow measurement data, Pudding Subbasin (cfs)*

| Stream Area | Appropriated Surface Water 1/ | | Instantaneous Minimum Flows Measured | | | |
|---|---|---|---|---|---|---|
| | Non-Consumptive | Consumptive | Instantaneous Discharge | Location | Date 2/ | Source 2/ |
| Molalla River | 25 | 36 | 20 | River mile 6.0 | Aug. 27, 1959 (1928-59) (1963-67) | USGS |
| Milk Creek System | 12 | 35 | 18 | Mouth | Sept. 26, 1962 | OSGC |
| Other tributaries to Molalla River | 11 | 27 | - | - | - | - |
| Pudding River | 0.0 | 60 | 26 | River mile 8.1 | Aug. 13, 14, 1961 (1928-1967) | USGS |
| Abiqua Creek System | 1.4 | 55 | 14 | River mile 1.2 | Aug. 28, 1962 | OSGC |
| Butte Creek System | 0.3 | 42 | .15 | At Monitor, River mile 7.7 | Aug. 25, 1967 (1936) (1940-52) (1966-67) | USGS |
| Drift Creek System | 42 | 5.6 | - | - | - | - |
| Silver Creek System | 0.4 | 15 | 2.0 | River mile 3.4 | Aug. 20, 21, 1967 (1963-1967) | USGS |
| Other tributaries to Pudding River | 1.2 | 1.4 | - | - | - | - |
| Mill Creek System | 320 | 24 | 0 | At Salem, River mile 2.1 | Oct. 2, 1938 (1938-1967) | USGS |

1/ *Oregon State Water Resources Board records, April 1966.*
2/ *U. S. Geological Survey Periods of available records are shown in parenthesis. Oregon State Game Commission listings are the lowest of flows measured monthly in low discharge periods of 1961 and 1962.*

Extensive logging in the upper Molalla drainage impairs water quality and contributes to formation of log jams that block the upstream migration of anadromous fish. Gravel mining in Molalla River near Canby often causes high stream turbidity and siltation of the streambed. Considerable bank revetment and channel straightening have recently been completed in the 15-mile section of the Molalla between the Cities of Canby and Molalla. Reduction in fish spawning and rearing area, creation of passage problems over riffles, loss of shelter and living space, and increases in water temperature have resulted.

A few unladdered or inadequately laddered dams influence anadromous fish migration. Two dams on Mill Creek were recently fitted with temporary passage facilities by the Fish Commission and action is underway toward the construction of proper ladders. All other major Mill Creek dams are now laddered. The 12-foot high Silverton municipal water supply dam on Abiqua Creek at river mile 11 is equipped with an inadequate fish ladder (Photo **II-31)** The ladder entrance is about 50 feet below the dam, and salmon and steelhead commonly bypass the entrance to jump unsuccessfully at the dam. Location and description of dams limiting fish production are given in Table II-37.

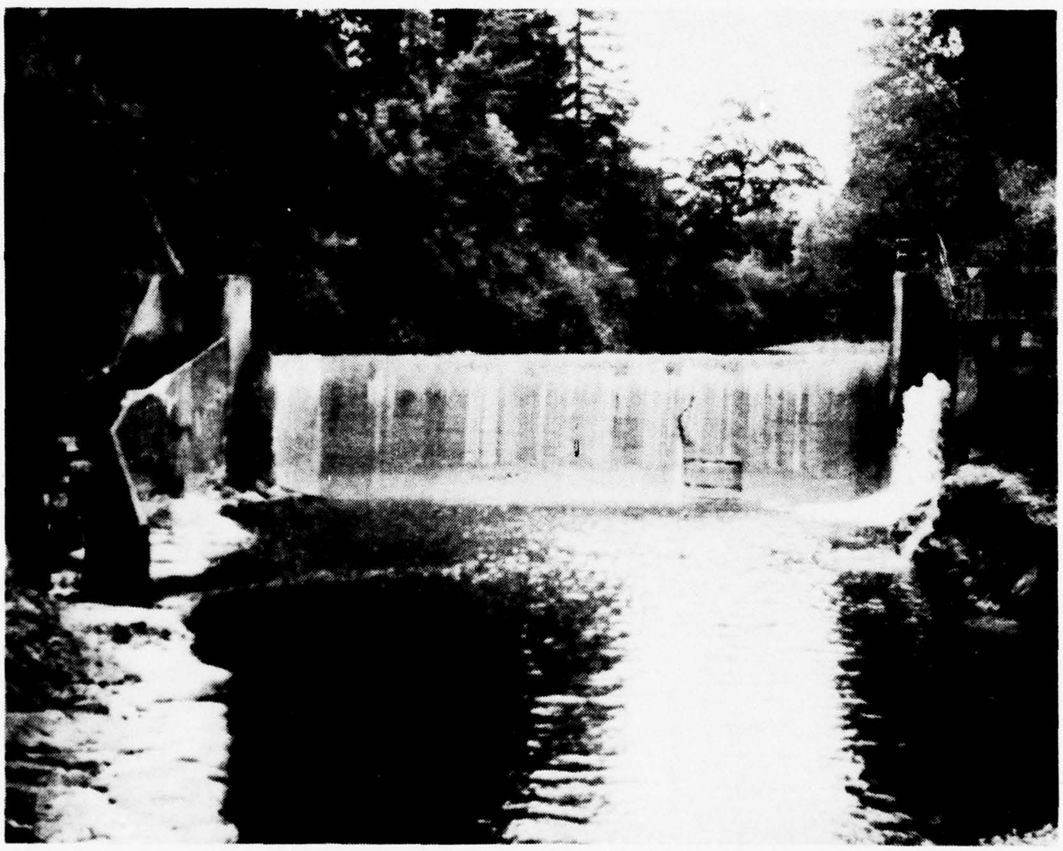


*Photo II-31. The Silverton municipal water supply dam on Abiqua Creek has an inadequate fish ladder. (Oregon Game Commission photo)*

Pudding River contains small quantities of gravel suitable for anadromous fish spawning. Low elevation portions of both Molalla and Pudding Rivers are subject to low flows and have high water temperatures during low flow periods. This serves to limit the use of these areas for salmonid rearing and favors production of warm-water species that compete with salmonids.

## Developments Beneficial to Fish Resources

Descriptions of fish ladders over natural barriers in subbasin streams are included in Table II-37. Occasionally log jams have been removed and cascades or low falls have been blasted to improve passage for anadromous fish.

This subbasin contains 55 private stocked fish ponds. These are not open to the public except for those operated on a fee-fishing basis.

Table II-40 shows minimum streamflow stipulations established in the subbasin. Future appropriations may be made only for domestic or livestock uses from natural flows of these streams. Also, the Molalla River system, upstream from and including the Table Rock Fork drainage, is protected from significant future water withdrawals by the State Water Resources Board. This stipulation applies as well to all natural lakes, other than those privately owned, located above the 2,000-foot elevation. Recommended minimum flows as developed by Oregon State Game Commission are shown in Table II-41.

Table II-42 lists numbers of fish stocked from 1961 through 1965. Large numbers of anadromous fish, particularly coho, were liberated in several years prior to 1961. Warm-water game fish are produced at the Oregon State Game Commission St. Paul fish ponds.

Table II-40

*Minimum streamflow stipulations established by the Oregon State Water Resources Board*

| Stream | Location | Minimum Flows (c.f.s.) |
|---|---|---|
| Pudding River and tributaries | Upstream from USGS gage 14-2020 at river mile 8.1 | 35 |
| Pudding River and tributaries | Upstream from USGS gage 14-2010 at river mile 40.4 | 10 |
| Molalla River and tributaries | Upstream from USGS gage 14-2000 at river mile 5.7 | 60 |
| Molalla River and tributaries | Upstream from USGS gage 14-1985 at river mile 32.3 | 35 |

Table II-41

*Numbers of fish stocked in Pudding Subbasin, 1961-1965*

| Stream System | Species | Mean Length (Inches) | Number per pound | 1961 | 1962 | 1963 | 1964 | 1965 | Agency |
|---|---|---|---|---|---|---|---|---|---|
| Molalla | Fall Chinook | - | 950 | | | | 3,703,100 | | USFWS |
| " | " " | - | 1200 | | | | | 401,800 | FCO |
| " | Spring Chinook | - | 27 | | | | 181,100 | | USFWS |
| " | " " | - | 139 | | | | 73,000 | | FCO |
| " | Coho | - | 17 | | | | | 19,700 | " |
| " | " | - | 918-1200 | | 117,400 | 324,300 | | 400,000 | " |
| " | Steelhead | - | 26-38 | 19,700 | 106,000 | 50,300 | | 50,700 | USFWS |
| " | Rainbow | 8 & over | - | 21,200 | 23,000 | 16,200 | 14,000 | 13,000 | OSGC |
| Mill Creek | " | " | - | 1,500 | 1,500 | 1,600 | 1,500 | 1,400 | " |
| Pudding | Spring Chinook | - | 139 | | | | 62,600 | | FCO |
| " | Coho | - | 80-140 | | | | | 231,300 | " |
| " | " | - | 918-1325 | | 43,800 | 361,800 | | | " |
| " | Rainbow | 8 & over | - | 18,500 | 18,500 | 18,600 | 16,100 | 17,100 | OSGC |

Table II-42

*Minimum flows for fish life recommended to Oregon State Water Resources Board by Oregon State Game Commission (cfs) 1/*

| Stream | Location | Dec.-May | June | July | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|
| Molalla R. 2/ 3/ | Confl. with Pudding R. | 300 | 200 150 | 100 80 | 80 | 80 300 | 300 | 300 |
| " " 3/ | Upstream from confl. of N. Fk. Molalla | 140 | 120 90 | 50 | 50 | 50 140 | 140 | 140 |
| " " 3/ | Upstream from confl. of Table Rock | 80 | 50 30 | 20 | 20 | 20 80 | 80 | 80 |
| Cedar Cr. | Mouth | 5 | 3 1 | 1 | 1 | 1 | 3 5 | 5 |
| Dickey Cr. | " | 5 | 3 2 | 2 | 2 | 2 | 2 3 | 5 |
| Gawley Cr. | " | 20 | 15 9 | 7 5 | 3 | 3 | 9 15 | 20 |
| Gribble Cr. | " | 13 | 13 10 | 7 5 | 3 | 3 | 6 10 | 13 |
| Milk Cr. | " | 85 | 60 45 | 40 30 | 20 | 20 | 20 40 | 85 |
| " " | Confl. of Nate Cr. | 40 | 40 30 | 20 15 | 10 | 10 | 30 | 40 |
| Canyon Cr. | Mouth | 30 | 8 6 | 4 | 4 | 4 | 4 8 | 30 |
| Bee Cr. | " | 12 | 4 3 | 2 | 2 | 2 | 2 4 | 12 |
| Mill Cr. | " | 9 | 6 3 | 2 | 1 | 1 | 1 3 | 9 |
| Jackson Cr. | " | 12 | 6 3 | 1 | 1 | 1 | 2 6 | 12 |
| Nate Cr. | " | 20 | 6 4 | 3 | 3 | 3 | 3 6 | 20 |
| N. Fk. Nate Cr. | " | 8 | 4 2 | 1 | 1 | 1 | 3 6 | 8 |
| Woodcock Cr. | 1 mi. upstream from mouth | 10 | 3 2 | 1 | 1 | 1 | 3 7 | 10 |
| N. Fork Molalla R. | Mouth | 80 | 50 30 | 20 | 20 | 20 80 | 80 | 80 |
| Ogle Cr. | " | 25 | 10 5 | 3 1 | 1 | 1 | 5 15 | 25 |
| Pine Cr. | " | 50 | 7 5 | 4 3 | 3 | 3 | 10 20 | 50 |
| Pudding River 2/ | " | 80 | 60 | 50 40 | 40 | 40 | 60 | 80 |
| Abiqua Cr. | " | 75 | 60 40 4/ | 25 20 4/ | 15 4/ | 15 4/ | 25 | 40 60 |
| " " | Confl. of L. Abiqua Cr. | 50 | 50 20 | 15 | 10 | 10 30 | 30 | 50 |
| L. Abiqua Cr. | Mouth | 20 | 10 9 | 5 4 | 3 | 3 | 3 6 | 10 20 |
| Powers Cr. | " | 25 | 10 5 | 3 | 3 | 3 | 3 8 | 15 25 |
| Butte Cr. | " | 75 | 50 35 | 20 16 4/ | 12 4/ | 12 4/ | 20 30 | 40 75 |
| Drift Cr. | " | 40 | 20 5 | 5 3 | 2 | 2 | 3 10 | 20 40 |
| E. Fk. Drift Cr. | " | 20 | 15 3 | 3 1 | 1 | 1 | 1 4 | 10 20 |
| W. Fk. Drift Cr. | " | 10 | 10 2 | 2 1 | 1 | 1 | 1 3 | 7 10 |
| Silver Cr. | " | 60 | 50 35 | 20 16 | 12 | 12 | 15 30 | 40 60 |
| Table Rock Fork | " | 80 | 50 30 | 20 | 20 | 20 80 | 80 | 80 |
| Trout Creek | " | 35 | 8 6 | 4 | 4 | 4 | 10 15 | 25 35 |

1/ *Where 2 figures are shown, minimums change during the month.*
2/ *Minimum spawning flows for coho salmon are included where potential exists but the species might not be present.*
3/ *Spawning flow recommendations by Fish Commission of Oregon.*
4/ *The flow figures consider only quantity requirements and will not be adequate to correct the existing high temperature problems existing in these streams.*

## Present Economy

Subbasin streams furnish an estimated 400 winter steelhead, 3,800 coho, and 1,300 spring chinook to the annual commercial harvest from Columbia River and Pacific Ocean. This amounts to 53,000 pounds of fish valued at $24,000.

Approximately 100 winter steelhead, and 100 coho and spring chinook salmon were caught by anglers during 1965 in the subbasin. Most of the relatively low stream angling pressure is on steelhead in the Molalla River. A total of 700 winter steelhead, 1,000 coho, and 700 spring chinook produced in subbasin streams were caught in 1965 by sport fishermen in the Pacific Ocean, Columbia and Willamette Rivers and in the subbasin. Angler use of steelhead and salmon produced in the subbasin amounted to 12,000 fisherman-days valued at $72,000 in 1965.

Angling pressure for wild cutthroat and hatchery rainbow trout is heavy in the spring on subbasin streams, but there is little angling pressure on the lakes. An estimated 25,500 trout, including some juvenile anadromous fish, were caught in 25,000 angler-days valued at $75,000 in 1965.

There is little angling pressure on warm-water species in the basin, and little is known of the overall species composition and catch. Economic value of these fish in the subbasin is low compared to the value of cold-water species.

SUBBASIN 8 - TUALATIN

## Habitat

Nearly all Tualatin Subbasin streams and a few small ponds provide important habitat for fish. Tualatin River, 83 miles in length, drains 710 square miles and enters Willamette River from the west about 2 miles upstream from Willamette Falls (Map II-8). Most of the drainage area lies in the flat valley floor and most of the streams flow through agricultural land. Only the upper 10 miles of the Tualatin and upper portions of a few of its tributaries rise on the eastern slope of the Coast Range. Most other streams have slight gradients.

The most critical factor limiting salmon and trout production is low, warm streamflow in the summer which affords poor shelter conditions for fish and greatly increases competition for food, shelter, and living space. Competition between individual salmonids is not generally as serious as competition from nongame fish which thrive in the poor environments.

Stream discharges are typical of west side Willamette River tributaries, being subject to large seasonal variations. Flows in the lower 65 miles of Tualatin River become extremely low or intermittent each summer. Normally, low flows occur in nearly all tributaries in summer and autumn (Table II-43).

*Photo II-32. Bronson Creek in Tualatin Subbasin. "Waste" areas such as this are rapidly disappearing from Willamette Basin. (Soil Conservation Service photo)*

Table II-43

*Appropriated surface water and minimum streamflow measurement data, Tualatin Subbasin (cfs)*

| Stream Area | Appropriated Surface Water 1/ | | Instantaneous Minimum Flows Measured | | | |
|---|---|---|---|---|---|---|
| | Non-Consumptive | Consumptive | Instantaneous Discharge | Location | Date 2/ | Source 2/ |
| Tualatin River | 58 | 123 | 0.08 | Near Dilley, River mile 58.8 | Sept. 3, 1967 (1939-1967) | USGS |
| Gales Creek System | 6 | 52 | 1.0 | About River mile 9.0 | Aug. 19, 1947 (1940-1967) | USGS |
| Dairy Creek System | 5.3 | 102 | 7.0 | East Fork at about River mile 8.0 | Sept. 10-12, 1944 (1940-1967) | USGS |
| McKay Creek System | 0.1 | 21 | 0.4 | River mile 13.0 | Aug., 17, 18, 22, 1951 (1940-1943) (1948-1967) | USGS |
| Scoggins Creek System | 10 | 20 | 0.1 | Near Gaston, River mile 1.7 | Several days in 1958 and 1961 (1939-1967) | USGS |
| Other tributaries to the Tualatin River | 3 | 97 | - | - | - | - |

1/ *Oregon State Water Resources Board records, April 1966.*
2/ *U. S. Geological Survey periods of available records are shown in parenthesis.*

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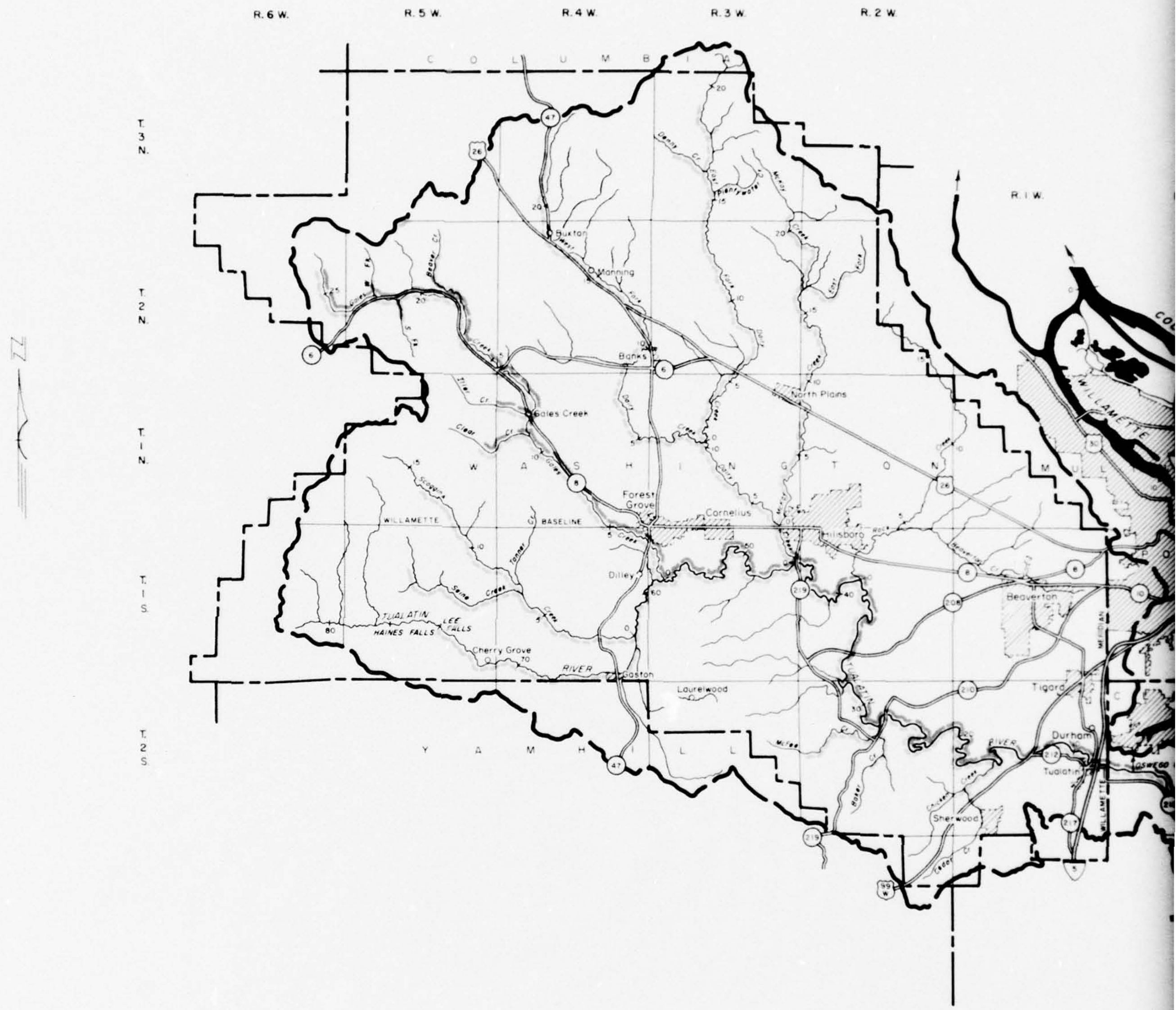
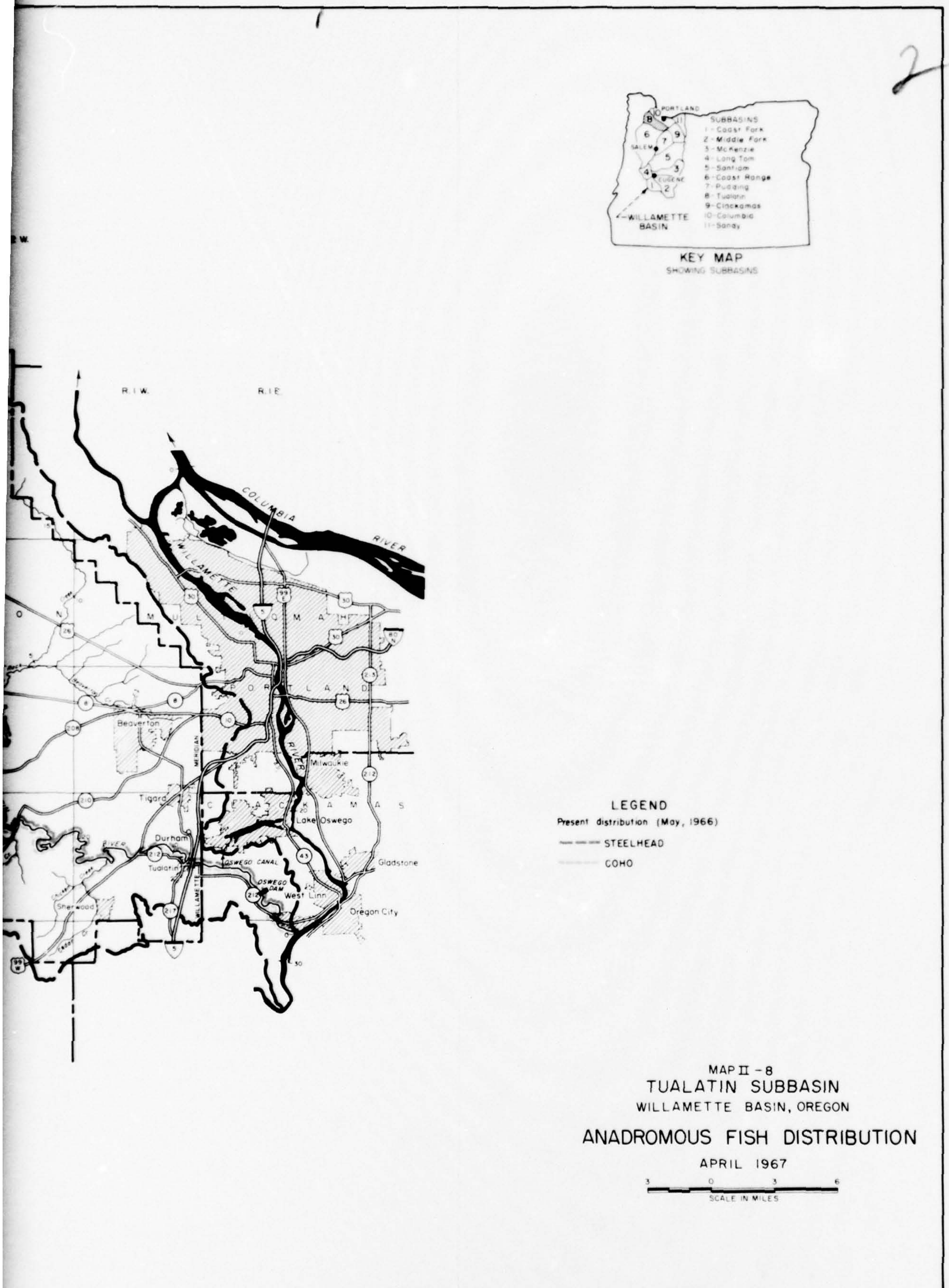
WILLAMETTE BASIN TASK FORCE
of the
PACIFIC NORTHWEST RIVER BASINS COMMISSION



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Nearly flat stream gradients and slow flows contribute to warm stream temperatures during summer periods of low rainfall. Summer temperatures in all but higher elevation streams usually range from 55° to 75° F. Temperatures as high as 75° and 80°F commonly occur throughout most of the Tualatin River and greatly limit salmon and trout production.

Spawning gravel for anadromous fish and trout is plentiful in most major tributary systems, and in Tualatin River from Cherry Grove near river mile 70 upstream approximately 5 miles to Lee Falls. Of the tributaries, Gales, Scoggins, East Fork Dairy, and McKay Creeks contain the best gravel and receive the heaviest use by anadromous fish. Tualatin River downstream from Cherry Grove has limited quantities of spawning gravel but is valuable as a salmon and steelhead migration route.

## Species and Distribution

Coho salmon are the most numerous and widespread of the anadromous fish in this subbasin. The annual spawning escapement averages approximately 3,400 coho. Tualatin River upstream from Cherry Grove and Gales, McKay, Scoggins, and East Fork Dairy Creeks produces the bulk of the run.

The 1965 winter steelhead run was 400 fish, all or most of which, spawned in Gales Creek. This run is believed to approximate the average run. Map II-8 shows known steelhead and coho distribution in subbasin streams. Records indicate the subbasin once supported a small run of chinook salmon.

Wild cutthroat trout are found in low to moderate numbers in most streams with perennial flows. Highest populations are present in the headwater streams having cool summer water temperatures. Substantial numbers of anadromous cutthroat trout enter the Tualatin system in winter and spring to spawn. Legal-sized rainbow or cutthroat are stocked in the larger streams each spring to supplement natural cutthroat populations for trout angling.

Warm-water game fish common to the Willamette River also inhabit the streams of the lower Tualatin drainage. Largemouth bass and bullhead catfish populations are more dense in the Tualatin than in any other Willamette River tributary, with the possible exceptions of the Yamhill and Long Tom Rivers.

Many nongame fish species are scattered throughout the subbasin. Largescale suckers, redside shiners, dace, and sculpins have wide distribution and large populations. Dace and sculpins are the only nongame forms common in the small, higher elevation streams.

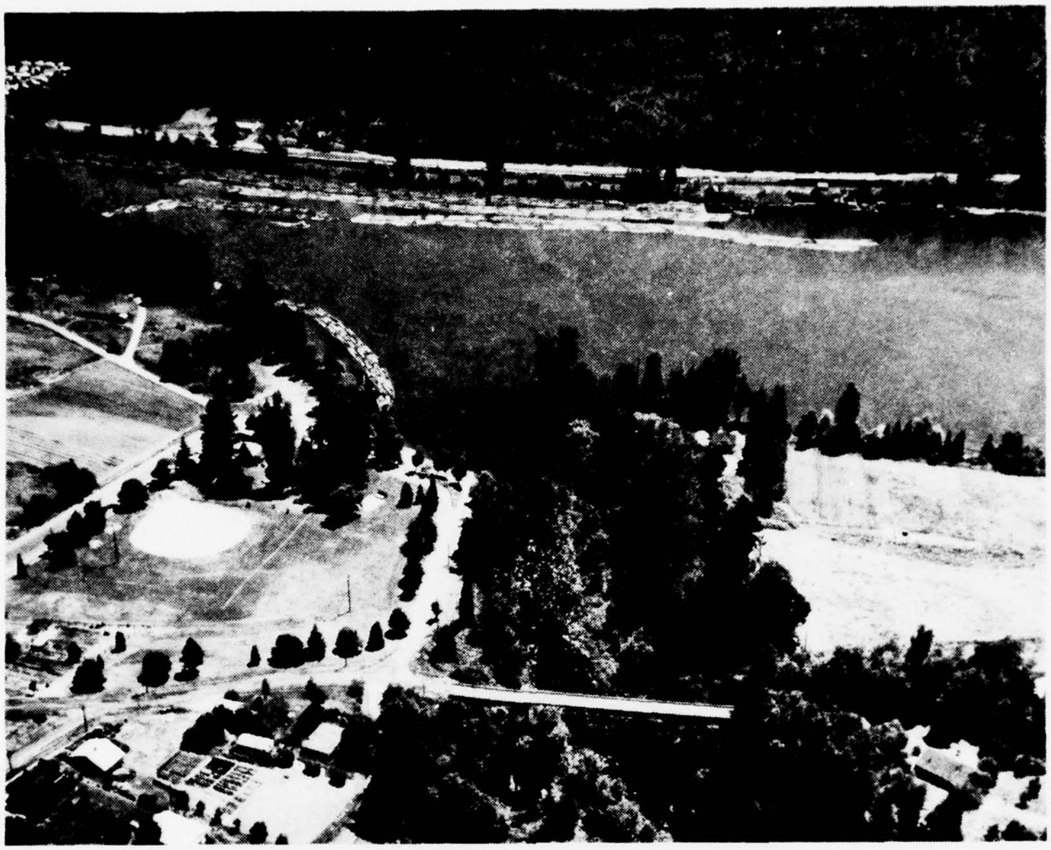


*Photo II-33. Tualatin River joins the Willamette. (Oregon State Highway Department photo)*

## Developments and Conditions Adversely Affecting Fish Resources

A concrete and board dam is located in Tualatin River at mile 3.8. This structure is used to divert water to Oswego Lake through a large unscreened canal that leaves the river about 3 miles above the dam. The dam, with boards installed, is approximately 6 feet high and forms a barrier to the upstream migration of adult coho salmon, especially during low flow periods in the fall. A wooden ladder over the dam was washed away in 1959 and has not been replaced. Sometimes practically no water passes the dam during summer and fall, preventing upstream migration of adult coho. Steelhead migrate upstream during periods of higher streamflow and thus have less difficulty in passing the dam. Effects of the unscreened Oswego Lake canal upon juvenile salmon and steelhead are discussed in the Columbia Subbasin "Developments Adversely Affecting Fish Resources" section.

Dissolved oxygen concentrations less than 5 parts per million are common in the lower river in low flow periods. Increased pollution, coupled with the deteriorated water quality in this area, could eliminate resident trout and warm-water game fish populations and preclude establishment of runs of fall chinook.

Surface water rights in the subbasin total nearly 500 cubic feet per second (Table II-43). About 85 percent is for consumptive use. The major consumptive use is for irrigation from Tualatin River, Dairy Creek, McKay Creek, and Gales Creek.

Twelve-foot high Lee Falls at river mile 74.7, and 16-foot Haines Falls at river mile 76.9, on the main river, are the most limiting of the few natural barriers to anadromous fish migration in the subbasin.

## Developments Beneficial to Fish Resources

No hatcheries are located in the subbasin except a small commercial trout hatchery operated in connection with a fee-fishing area. Table II-44 lists trout and anadromous fish liberations made in the Tualatin drainage in the 1961-1965 period. Coho runs in some streams have increased significantly, partially resulting from liberations started in 1954.

Table II-44

*Numbers of fish stocked in Tualatin Subbasin, 1961-1965*

| Species | 1961 | 1962 | 1963 | 1964 | 1965 | Agency |
|---|---|---|---|---|---|---|
| Coho fry | | | 195,000 | | | FCO |
| Legal Cutthroat | 9,000 | | 5,000 | 6,000 | 2,000 | OSGC |
| Legal Rainbow | 10,000 | 4,000 | 13,000 | 8,000 | 30,700 | OSGC |

Table II-45 shows minimum flow stipulations established for the subbasin. These stipulations substantially limit future water appropriations from natural flows of the listed stream areas and should greatly assist in protecting fish resources from future loss.

The subbasin contains 26 private stocked fish ponds. These are not open to the public except those operated on a fee basis.

A listing of recommended minimum streamflows made by Oregon State Game Commission for this subbasin is presented in Table II-46.

Table II-45
*Minimum streamflow stipulations established by the Oregon State Water Resources Board*

| Stream | Location | Minimum Flows (cfs) |
|---|---|---|
| Tualatin River or tributaries | Upstream from river mile 70.0 | 10 (July 16-Nov. 15)<br>65 (Nov. 16-May 31)<br>20 (June 1-July 15) |
| Tualatin River or tributaries | Upstream from USGS gage 14-2035 near Dilley, Oregon | 15 (Aug. 1-Sept. 30) |
| Tualatin River or tributaries | Upstream from USGS gage 14-2075 at West Linn, Oregon | 15 (July 16-Sept. 30)<br>30 (Oct. 1-May 31)<br>20 (June 1-July 15) |
| Seine Creek or tributaries | Upstream from the mouth | 2 (July 1-Nov. 15)<br>25 (Nov. 16-May 31)<br>8 (June) |
| Tanner Creek or tributaries | Upstream from the mouth | 1 (Aug. 1-Sept. 30)<br>9 (Nov. 15-May 31) |
| Gales Creek or tributaries | Upstream from the mouth | 12 (July 16-Oct. 31)<br>100 (Nov. 1-May 31)<br>35 (June 1-July 15) |
| Gales Creek or tributaries | Upstream from river mile 12.0 | 8 (Sept. 1-Oct. 15)<br>70 (Nov. 15-May 31) |
| Beaver Creek or tributaries | Upstream from the mouth | 1 (July 16-Nov. 15)<br>17 (Nov. 16-May 31)<br>3 (June 1-July 15) |
| Little Beaver Creek or tributaries | Upstream from the mouth | 1 (Aug.1-Sept. 30) |
| North Fork of Gales Creek or tributaries | Upstream from the mouth | 1.5 (July 16-Nov. 15)<br>25 (Nov. 16-May 31)<br>3 (June 1-July 15) |
| South Fork of Gales Creek or tributaries | Upstream from the mouth | 1 (July 16-Nov. 15)<br>20 (Nov. 16-May 31)<br>2 (June 1-July 15) |
| East Fork of Dairy Creek or tributaries | Upstream from river mile 13.0 | 12 (July 16-Nov. 15)<br>50 (Nov. 16-May 31)<br>24 (June 1-July 15) |
| Denny Creek or tributaries | Upstream from the mouth | 2 (Aug. 1-Nov. 15)<br>15 (Nov. 16-May 31)<br>3 (June 1-July 31) |
| Plentywater Creek or tributaries | Upstream from the mouth | 1 (Aug. 1-Nov. 15)<br>5 (Nov. 16-May 31)<br>2 (June 1-July 31) |
| McKay Creek or tributaries | Upstream from river mile 15.5 | 4 (Aug. 1-Sept. 30)<br>36 (Nov. 16-May 31) |
| East Fork of McKay Creek or tributaries | Upstream from the mouth | 2 (Aug. 1-Sept. 30) |
| McFee Creek or tributaries | Upstream from Gulf Canyon Creek | 2 (Aug. 1-Sept. 30)<br>12 (Nov. 15-May 31) |

Table II-46

*Minimum flows for fish life recommended to Oregon State Water Resources Board by Oregon State Game Commission (cfs) 1/*

| Stream | Location | Dec.-May | June | July | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|
| Tualatin R. | USGS gage 2075 (West Linn) | 30 | 25 | 20 15 | 15 | 15 | 30 | 30 |
| " " | USGS gage 2035 (Dilley) | 30 | 25 | 20 15 | 15 | 15 | 30 | 30 |
| " " 2/ | River mile 70 | 65 | 30 20 | 15 10 | 10 | 10 | 10 15 | 20 65 |
| Dairy Creek | Mouth | 15 | 15 | 12 10 | 10 | 12 | 15 | 15 |
| E. Fk. Dairy Cr. 2/ | River mile 13 | 50 | 30 25 | 25 15 | 10 | 10 | 10 12 | 15 50 |
| Denny Cr. 2/ | Mouth | 15 | 4 3 | 3 | 2 | 2 | 2 | 4 15 |
| Plentywater Cr. 2/3/ | " | 5 | 2 | 2 | 1 | 1 | 1 | 2 5 |
| McKay Cr. 2/3/ | River mile 15.5 | 36 | 18 9 | 4 | 4 | 4 | 10 18 | 36 |
| E. Fk. McKay Cr. | Mouth | 10 | 9 5 | 2 | 2 | 2 | 5 9 | 18 |
| Gales Creek 4/ | " | 100 | 50 35 | 35 15 | 12 | 12 | 12 15 | 100 |
| " " 4/ | River mile 12 | 70 | 40 25 | 15 8 | 8 | 8 | 8 20 | 40 70 |
| Beaver Creek 2/ | Mouth | 17 | 3 3 | 3 1 | 1 | 1 | 1 | 2 17 |
| Clear Creek 2/ | " | 17 | 10 6 | 3 | 3 | 3 | 3 | 5 17 |
| Iller Cr. 2/3/ | " | 23 | 5 3 | 2 1 | 1 | 1 | 1 2 | 2 23 |
| Little Beaver Cr. | " | 10 | 7 4 | 2 1 | 1 | 1 | 4 7 | 10 |
| N. Fk. Gales Cr. | " | 25 | 4 3 | 3 2 | 2 | 2 | 2 | 3 25 |
| S. Fk. Gales Cr. | " | 20 | 3 2 | 2 1 | 1 | 1 | 1 | 2 20 |
| McFee Creek | Confl. of Gulf Canyon Cr. | 12 | 12 10 | 7 4 | 2 | 2 | 4 7 | 10 12 |
| Scoggins Creek | Mouth | 40 | 25 15 | 12 6 | 6 | 6 | 15 30 | 40 |
| Seine Cr. | " | 25 | 10 6 | 3 2 | 2 | 2 | 2 | 3 25 |
| Tanner Cr. | " | 9 | 6 | 3 2 | 1 | 1 | 1 3 | 6 9 |

1/ *Where 2 figures are shown, minimums change during the month.*
2/ *The spawning flow listed is based on Fish Commission of Oregon studies.*
3/ *The lowest summer flow listed is the recommended minimum rearing flow based on Fish Commission of Oregon studies.*
4/ *The spawning flow listed is based on Oregon State Game Commission studies utilizing transects.*

## Present Economy

The streams of the Tualatin system annually provide an estimated 8,200 coho salmon and steelhead trout to the commercial fisheries of the Pacific Ocean and Columbia River. This catch amounts to an estimated 57,000 pounds of fish valued at $22,000.

The winter sport fishing season for anadromous fish, presently November to April, is open in the lower 45 miles of the Tualatin River. Angling pressure is light. Tributaries and the upper river are closed to fishing during this period to protect spawning fish. In 1965, 2,100 coho and steelhead of subbasin origin were harvested in the sport fisheries of the subbasin, Willamette River, Columbia River, and the Pacific Ocean. In that year the total angler use of salmon and steelhead trout produced in subbasin streams was an estimated 2,600 angler-days valued at $15,600.

Wild cutthroat and hatchery-produced rainbow and cutthroat trout are subjected to moderate to high angling pressure. Most stocking and fishing occur in the larger streams during spring and early summer when flows are still relatively ample and cool. An estimated 35,100 trout were caught from subbasin streams in 1965. An estimated 20,200 angler-days valued at $61,000 were expended on this fishery.

Warm-water game fish receive light to moderate angling pressure. Fishing is concentrated principally in lower Tualatin River in spring and summer. Bullhead catfish and largemouth bass are the species most commonly caught. This fishery supports an estimated 11,100 angler-days use valued at $16,600 annually.

## SUBBASIN 9 - CLACKAMAS

Nearly all streams in Clackamas Subbasin are important for fish production and angling. More than 60 mountain lakes in the Cascade Range and 5 Portland General Electric Company reservoirs also contribute to the sport fishery.

### Habitat

The Clackamas River system contains approximately 840 miles of streams and drains 937 square miles of land (Map II-9). Clackamas River is a clear mountain stream with an average flow at the mouth of about 3,700 cfs. It has more uniform flows than many Willamette Basin streams except for fluctuations caused by reservoir operations.

About 85 percent of the watershed is forested, and the stream is well shaded upstream from river mile 25. Because of elevation and shading, water temperatures are relatively cool. Summer maximums usually are less than 70°F except in the lower sections of low elevation tributaries.

Downstream from river mile 25 much of the land has been cleared for agricultural purposes. Consequently, summer flows in the streams draining these areas--Deep, Eagle, and Clear Creeks--become low and water temperatures often exceed 70°F.

Clackamas River provides excellent habitat for trout and salmon. Stream gradient is moderate to steep throughout its length, and the stream bed is rich in gravel suitable for spawning. Abundant rearing area is provided by the relatively stable flows of high-quality water.

According to the Annual Report of the Oregon Fish Commissioners for 1899, Clackamas River was considered to be the best spring chinook stream in the state at that time. There are indications that runs prior to 1900 were several times greater than they are at present. Commercial fishing in the lower Clackamas River before the turn of the century, extensive egg-taking for Clackamas River salmon hatcheries, construction of hydroelectric dams, and perhaps other factors, contributed to depletion of the runs.

A number of falls on tributaries limit stream area available to anadromous fish. Considerable habitat is thus isolated in the North Fork, South Fork, Oak Grove Fork, Collawash, and Roaring River systems.

Mountain lakes in the subbasin are small in size, but provide good habitat for trout. The largest, Elk Lake, covers 63 surface acres.

Reservoirs formed as part of Portland General Electric Company's hydroelectric developments also provide habitat for fish. Timothy Lake, 1,401 surface acres, and Harriet Lake, 23 surface acres, are located on Oak Grove Fork; North Fork Reservoir, 350 surface acres, and River Mill Reservoir, 100 surface acres, are located on the Clackamas; and 70-acre Faraday Lake is between the two and adjacent to the main river (Figure II-4). Although commonly called "lakes", Timothy, Harriet and Faraday are actually reservoirs.

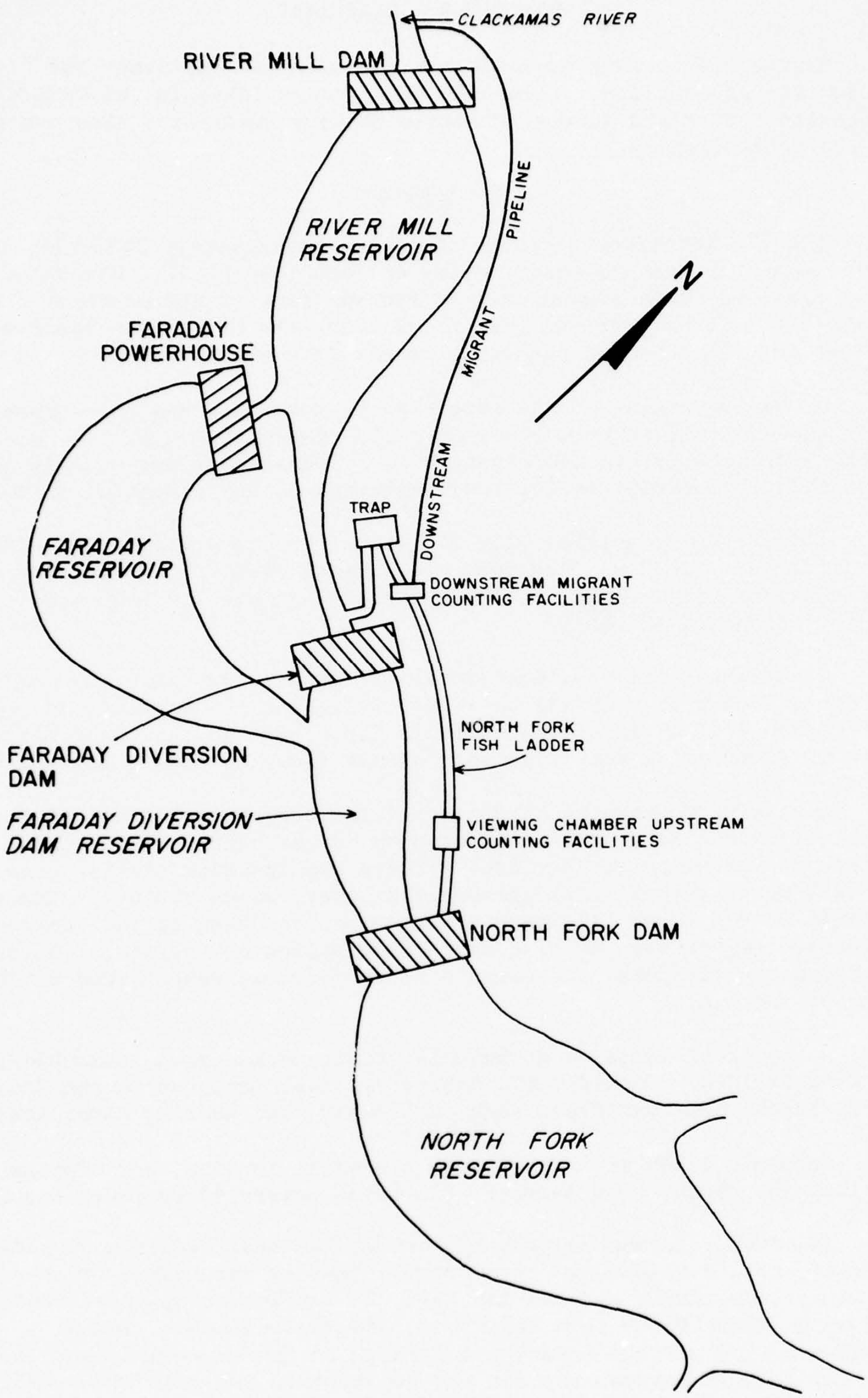
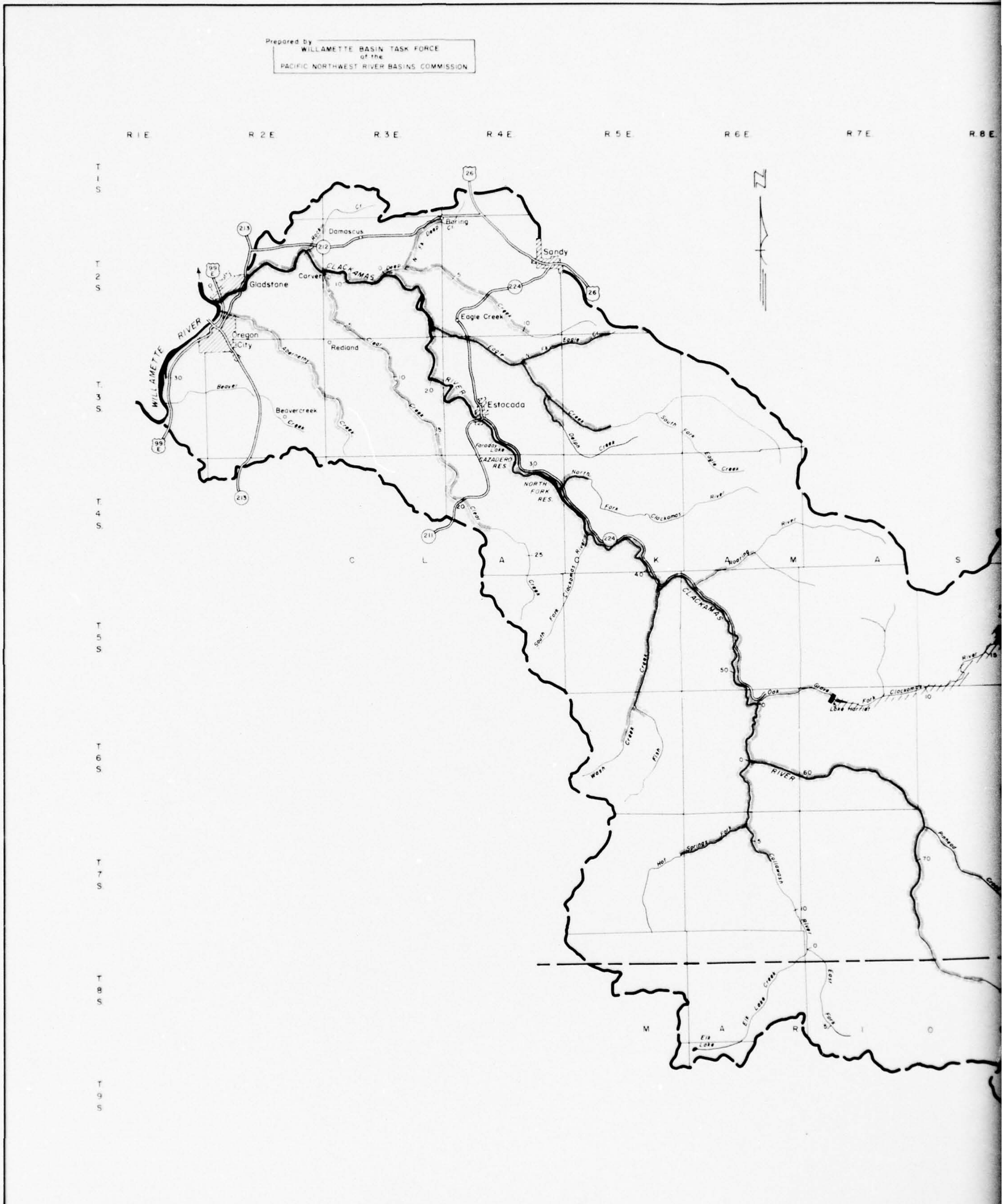
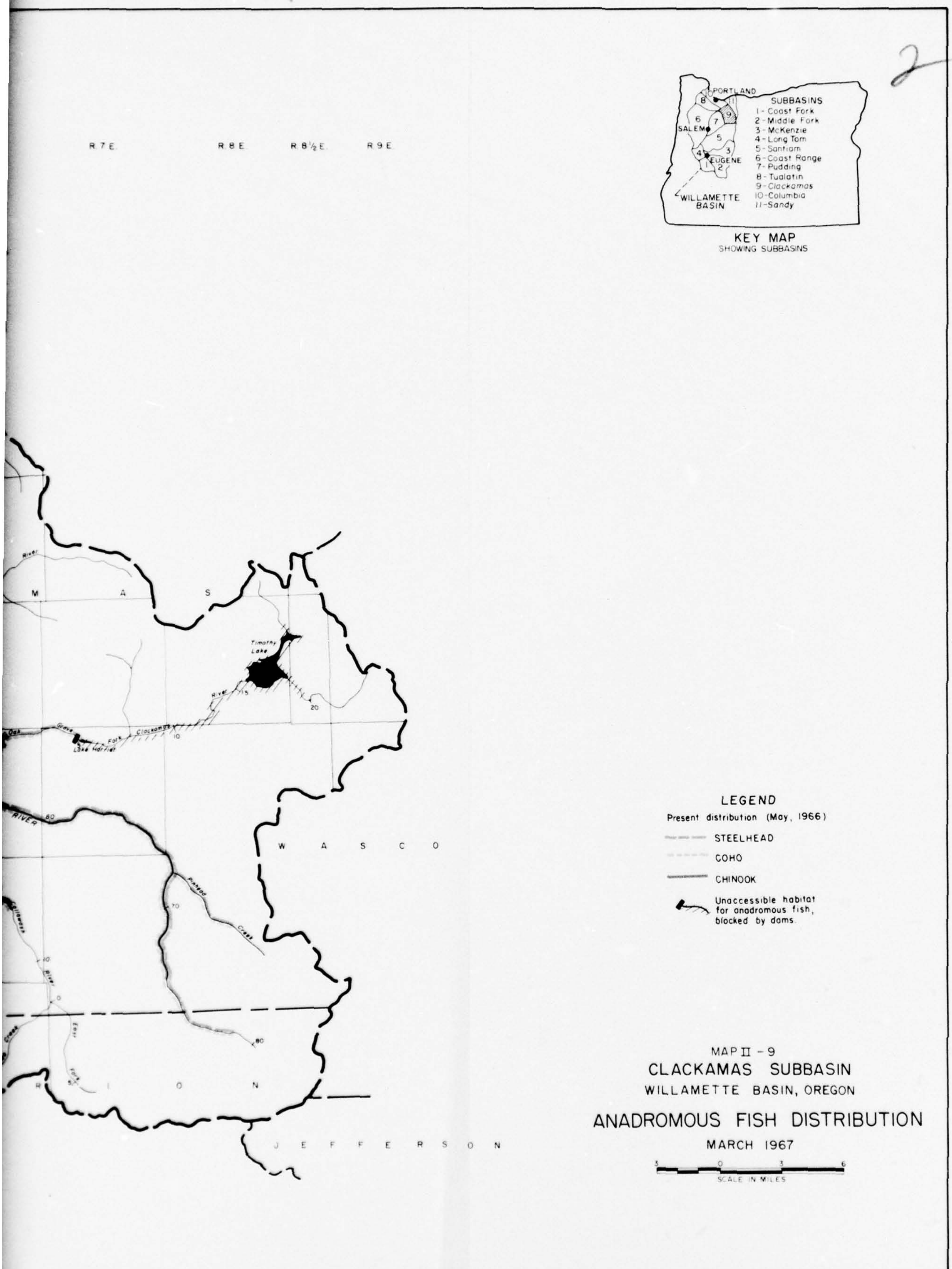



Figure II-4. Sketch of Clackamas River hydrolectric developments.



Prepared by
WILLAMETTE BASIN TASK FORCE
of the
PACIFIC NORTHWEST RIVER BASINS COMMISSION
R.1E.
R.2E.
R.3E.
R.4E.
R.5E.
R.6E.
R.7E.
R.8E.
T. 1 S.
T. 2 S.
T. 3 S.
T. 4 S.
T. 5 S.
T. 6 S.
T. 7 S.
T. 8 S.
T. 9 S.
Damascus
Boring
Sandy
Gladstone
Carver
Eagle Creek
Oregon City
Redland
Estacada
Beavercreek
WILLAMETTE RIVER
CLACKAMAS
RIVER
Faraday Lake
CAZADERO RES.
NORTH FORK RES.
North Fork Clackamas River
South Fork Eagle Creek
Roaring River
South Fork Clackamas River
Oak Grove Fork Clackamas
Lake Harriet
Hot Springs Fork Collawash River
Elk Lake
Elk Lake Creek
East Fork
C L A C K A M A S
M A R I O




WBTF-9-1171d-LL

## Species and Distribution

The river produces chinook salmon, coho salmon, and steelhead trout that contribute to the commercial and sport fisheries in Columbia River and Pacific Ocean, as well as to the sport fishery in the Willamette and Clackamas River systems. Anadromous fish distribution is shown in Map II-9.

In 1965, 12,000 coho salmon entered Clackamas River. Approximately 6,100 of these resulted from Eagle Creek National Fish Hatchery releases. The 1965 steelhead run was 5,500, and 1962 through 1964 spring chinook runs averaged 4,700 fish. These are believed to approximate the average runs. Approximately 100 fall chinook spawn in the lower river and in Eagle Creek, a tributary entering the Clackamas at river mile 16.7. Fall chinook numbers are expected to increase greatly with the cleanup of pollution in the lower Willamette.

Sport fishermen catch large numbers of rainbow and cutthroat trout and lesser numbers of whitefish, Dolly Varden and brown trout in the Clackamas system. Searun cutthroat trout are taken by anglers as far upstream as River Mill Dam. Brook trout are present in some headwater streams and in many of the lakes and reservoirs. Kokanee were stocked in Timothy Lake and a self-sustaining population has been established. Few warm-water game fish are present in subbasin streams because the water is too cold for favorable growth and reproduction.

Above North Fork Reservoir, there are few species and only small numbers of nongame fish to compete with and prey on salmonids. Suckers are plentiful in North Fork Reservoir, however, and in the river and reservoirs downstream. Carp and squawfish are common in the river downstream from River Mill Dam.

## Developments and Conditions Adversely Affecting Fish Resources

Dams have probably been the type of development most adverse to anadromous fish in the subbasin. The First and Second Annual Reports of the Fish and Game Protector to the Governor (1894) reported that a grist mill dam near Gladstone had eliminated most of the Clackamas River salmon run in 1891. The state hatchery located 4 miles upstream reported a decrease in egg take from 5,860,000 in 1890 to 800,000 the following year.

Two hydroelectric dams (River Mill and Cazadero) at river miles 23.4 and 28.2, at least in the past, have hindered or blocked the upstream migration of salmon and trout (Figure II-4). The precise effect of the dams is undocumented, but they may have been chiefly responsible for the decline of the salmon and steelhead runs in the river.

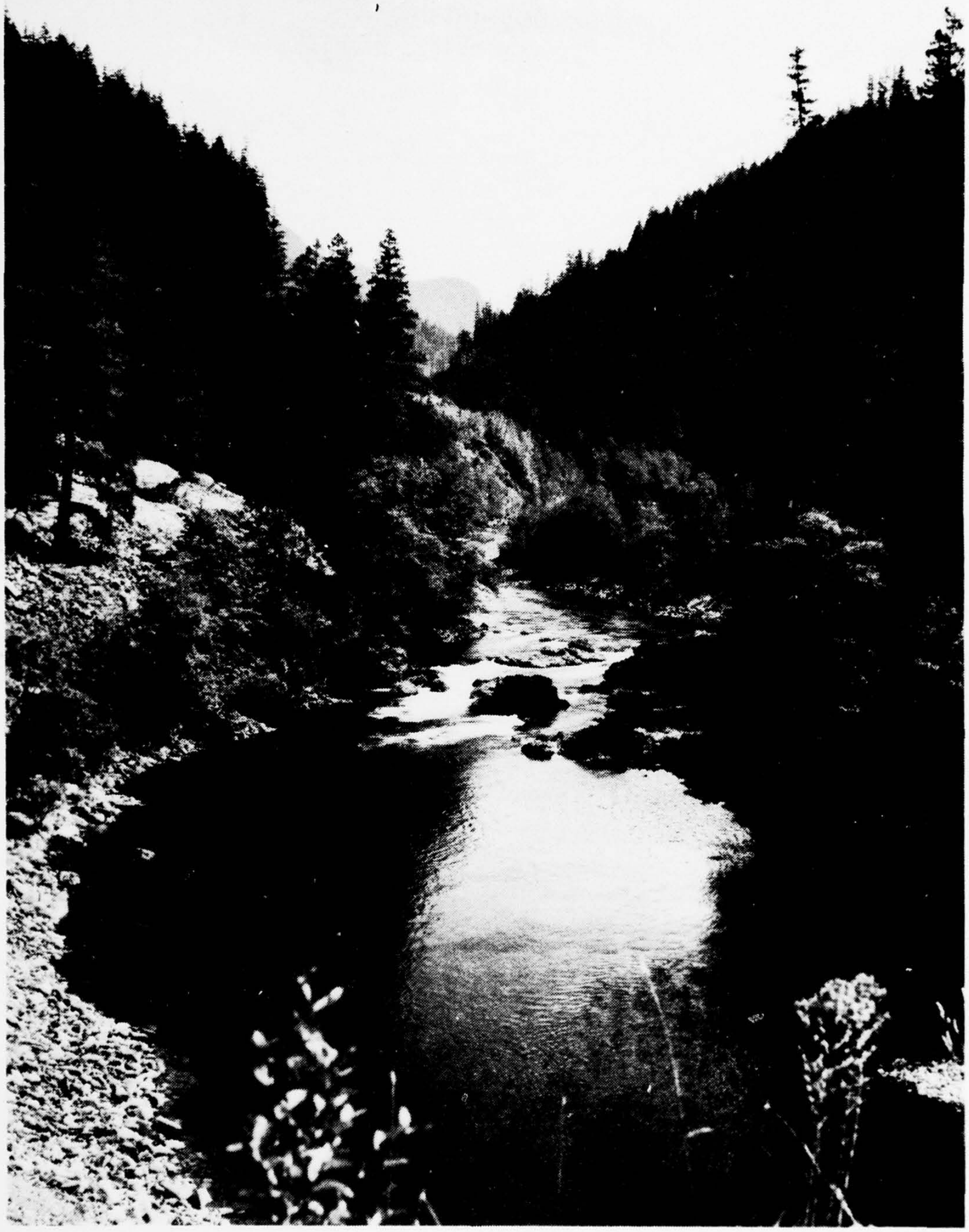


Photo II-34. *Clackamas River, a clear mountain stream near metropolitan Portland. (Oregon State Highway Department photo)*

The lower dam, River Mill, was constructed in 1911. It is a concrete structure 80 feet high. The middle dam, Cazadero, was a timber-crib structure about 70 feet high built in 1906. It was replaced in 1965 by a concrete structure and renamed Faraday Dam (Photo II-35). A third dam, North Fork, was built in 1958 at river mile 30. It is a concrete structure 206 feet high.

Whether the steep, narrow fishway at River Mill is adequate to pass salmon and steelhead is a moot question. The fishery management agencies have believed for some time that it is inadequate, and a study financed by Portland General Electric Company is now underway to answer the question. The fishway at Cazadero Dam washed away in 1917 and was not replaced until 1939, 22 years later. Thus, the streams above this point were closed for a considerable time to salmon and steelhead entry.

Since 1958 the fish passage picture at the hydroelectric dams has brightened. Adult salmon and steelhead enter the North Fork Dam fishway below Faraday Dam and exit above North Fork Dam (Figure II-4). Smolts (young salmon migrating to salt water) too, take advantage of this fishway. They are screened from the ladder and shunted downstream through a pipe to the pool below River Mill Dam. Adult runs of coho and steelhead have increased since the North Fork Dam fishway became operable, but spring chinook numbers have remained about the same.

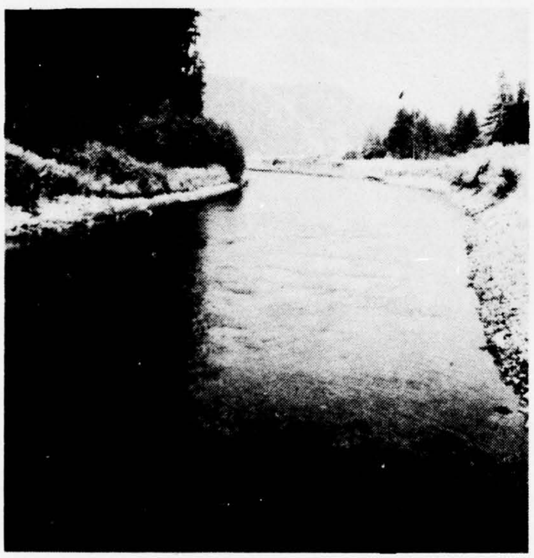


*Photo II-36. Faraday Power Canal. (Oregon State Game Commission photo)*

*Photo II-35. Faraday Dam and North Fork Fishway. (Oregon State Game Commission photo)*

*Photo II-37. Eagle Creek National Fish Hatchery, the only Federal hatchery in the basin.*

Power peaking operations at River Mill Dam cause severe daily fluctuations of flow. River discharges of 295 and 1,780 cfs measured at the U. S. Geological Survey gaging station just below River Mill Dam on September 18, 1964, are typical of daily flow extremes that occur while spring chinook are spawning. Even more severe fluctuations occur in the fall and winter. The fluctuations retard production of fish food organisms, disrupt salmon spawning, interfere with angling and other recreational uses, and strand fish.

Two Portland General Electric Company dams are located on Oak Grove Fork of Clackamas River. Since there are natural falls downstream from the dams, only resident trout are affected. The lower dam forms a 23-acre impoundment, Harriet Lake, from which water is diverted for power generation (Figure II-5). The upper dam forms Timothy Lake, a popular trout fishing impoundment of approximately 1,200 acres. Water from Timothy Lake is released to augment Harriet Lake. A minimum release of at least 10 cubic feet per second from Timothy Lake is required by law.

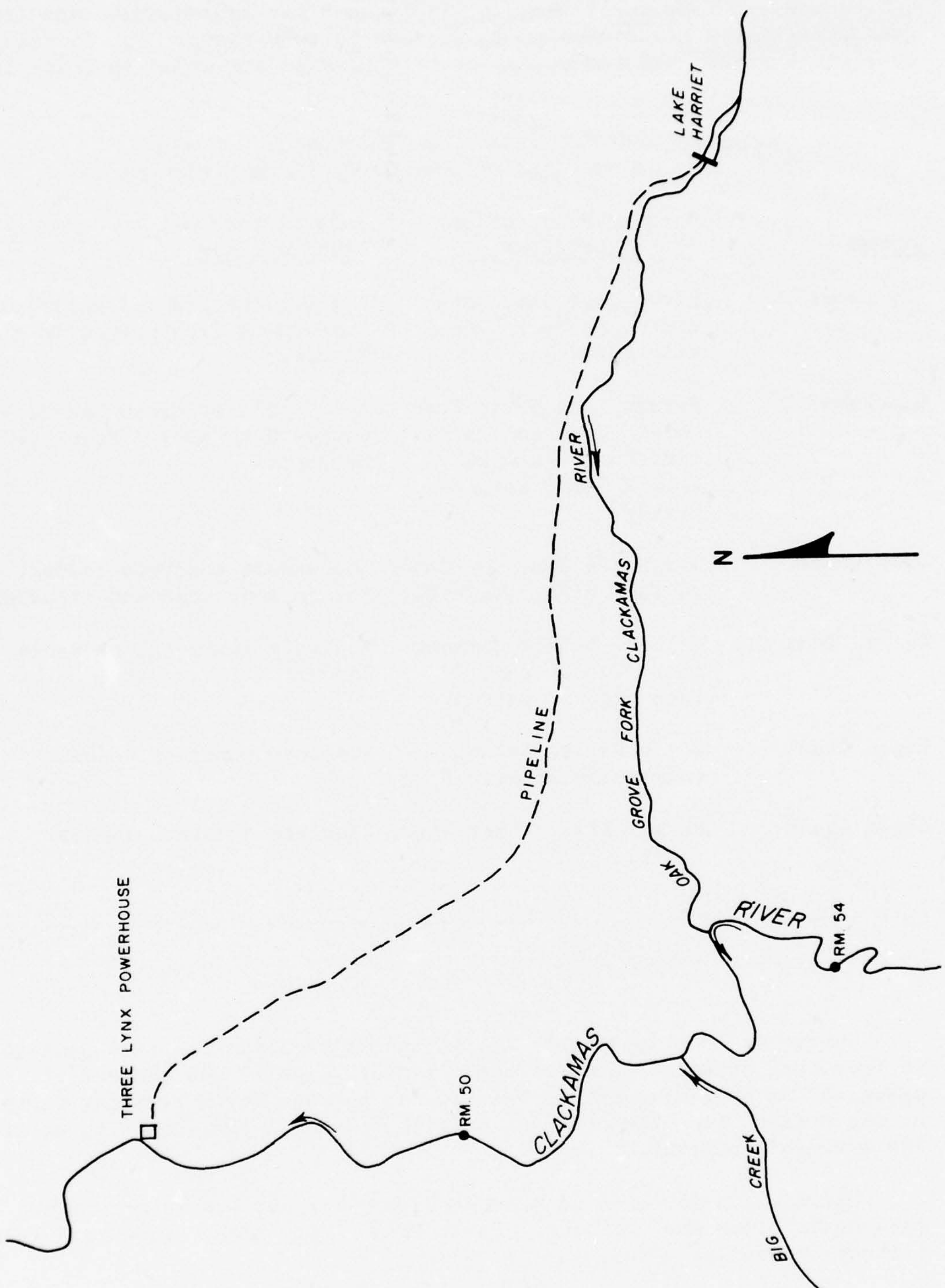



*Figure II-5. Sketch of Oak Grove Fork power diversion.*

There are four small dams on Clackamas River tributaries and fish passage at these structures is inadequate in some cases. The location of these barriers and the status of fish passage are given in Table II-47.

Table II-47
*Location and description of upstream fish passage facilities at barriers on Clackamas Subbasin streams* 1/

| Stream | Barrier Description and Location | Description of Fish Facility |
|---|---|---|
| Clackamas R. | River Mill Dam, concrete, 80 feet high. Mile 23.4. | A steep, narrow concrete ladder. Anadromous fish pass with difficulty. |
| Clackamas R. | Faraday and North Fork Dams. High concrete structures at mile 28.2 & 30.0, respectively. | A 1.7-mile concrete ladder bypasses both dams. Probably adequate. |
| Deep Creek | Sersanous Dam. Earthen, 20 feet high. Mile 8. | Inadequate concrete ladder. Passes some coho and steelhead. |
| N. Fk. Deep Cr. | Valberg Lumber Company Dam. Wooden dam, 7 feet high at Boring. | Recently improved, passable ladder. |
| Eagle Creek | Dwyer Falls, 6-foot rock falls at mile 5. | Adequate concrete ladder. |
| Eagle Creek | Rock falls 10 feet high at mile 9. | Adequate concrete ladder. |

1/ *Status as of August 1966.*

There are many impassable falls, and falls hindering fish passage, on tributary streams. Some of these isolate significant amounts of spawning and rearing habitat, but few can be considered limiting factors at the present time because runs of fish are not large enough to utilize the available habitat.

Excluding power rights, appropriations for surface water are not substantial from most streams. Table II-48 lists water rights and related minimum streamflow data.

Table II-48

*Appropriated surface water and minimum streamflow measurement data, Clackamas Subbasin (cfs)*

| Stream Area | Appropriated Surface Water 1/ | | Instantaneous Minimum Flows Measured | | | |
|---|---|---|---|---|---|---|
| | Non-Consumptive | Consumptive | Instantaneous Discharge | Location | Date 2/ | Source 2/ |
| Clackamas R. downstream from and including River Mill Dam | 4,300 | 89 | 385 | Gage 14-2110 River mile 4.8 | Sept. 13, 1963 (1911-1912) (1962-1967) | USGS |
| Clear Creek System | 5 | 15 | 20 | Mouth | Sept. 4, 1963 | OSGC |
| Deep Creek System | 0.6 | 12 | 7 | River mile 0.6 | Aug. 21, 1962 | OSGC |
| Eagle Creek System | 114 | 2.1 | 32 | River mile 0.5 | Aug. 21, 1962 | OSGC |
| Tickle Creek System | 1.2 | 3.7 | 4 | River mile 1.1 | Aug. 21, 1962 | OSGC |
| Other tributaries to Clackamas R. downstream from River Mill Dam | 3.3 | 7 | - | - | - | - |
| Clackamas R. upstream from River Mill Dam | 5,400 3/ | 2.2 | 324 | Gage 14-2095 River mile 47.8 | Oct. 17, 1958 (1909-13)(1921-65) | USGS |
| Collawash River System | 0.0 | 0.0 | 58 | Mouth | Sept. 5, 1963 | OSGC |
| N. F. Clackamas R. System | 0.8 | 0.1 | 10 | Mouth | Aug. 21, 1962 | OSGC |
| Oak Grove Fork System | 3/ | 0.4 | 90 | River mile 16 | Oct. & Nov. 1926 (1913-1929) | USGS |
| South Fk. Clackamas R. Sys. | 0.0 | 56 | 21 | Mouth | Sept. 5, 1963 | OSGC |
| Other tributaries to Clackamas R. upstream from River Mill Dam | 1.2 | 2.6 | - | - | - | - |

1/ *Oregon State Water Resources Board records, April 1966.*
2/ *U. S. Geological Survey periods of available records are shown in parenthesis. Oregon State Game Commission listings are the lowest of flows measured monthly in low discharge periods of 1962 and 1963.*
3/ *Includes Oak Grove Fork power rights.*

## Developments Beneficial to Fish Resources

Developments beneficial to fish include one hatchery and the ladders over natural barriers described in Table II-47. The large Federal hatchery located on Eagle Creek rears coho and spring chinook salmon and steelhead. Reservoirs formed as a part of the hydroelectric generation system provide some angling and rearing of salmonids. The reservoirs do not compensate for the loss of anadromous fish, however, because the dams impede both their upstream and downstream migration. The fishway built as a part of the North Fork Dam project has partially corrected the fish passage problem that was caused by the hydroelectric developments.

Waters of the subbasin are stocked each year with both resident and anadromous fish. Table II-49 indicates numbers and species of fish stocked in the watershed in recent years. The subbasin contains 111 private stocked fish ponds. These are not open to the public except for those operated on a fee-fishing basis.

Table II-50 shows minimum flow stipulations established in the subbasin. These stipulations substantially limit future water appropriations from natural flows of the listed stream areas and should greatly assist in protecting fish resources and enhancing recreation.

Recommendations for minimum streamflows have been made by the Game Commission and are presented in Table II-51.

Table II-49

*Numbers of fish stocked in Clackamas Subbasin, 1961-1965*

| Stream System or Lake | Species | Mean Length (Inches) | Number per pound | 1961 | 1962 | 1963 | 1964 | 1965 | Agency |
|---|---|---|---|---|---|---|---|---|---|
| Clackamas | Fall Chinook | - | 421-821 | | | | | 2,096,400 | FCO |
| " | " " | - | 26-45 | 2,193,600 | 2,435,500 | | 1,427,300 | 544,300 | USFWS |
| " | Spring Chinook | - | 1150-1264 | | | | 3,795,200 | 1,001,300 | FCO |
| " | " " | - | 36-62 | 533,400 | 180,900 | 940,600 | 3,728,300 | 1,630,700 | USFWS |
| " | Coho | - | 1,168 | | | | | 2,270,000 | FCO |
| " | " | - | 20-21 | | | | | 99,700 | " |
| " | " | - | 22-29 | 1,270,700 | 1,013,000 | 750,200 | 1,293,800 | | USFWS |
| " | Steelhead Yearling | - | - | | 8,000 | | | | OSGC |
| " | " | - | 15-44 | 98,800 | 179,700 | 451,100 | 333,900 | 117,400 | USFWS |
| " | Cutthroat | 8 & over | - | 8,000 | | | | | OSGC |
| " | Rainbow | " " | - | 113,700 | 125,800 | 126,900 | 102,300 | | " |
| Elk Lake | Brook trout | 2-4 | - | | | | 20,000 | | " |
| " " | Cutthroat | 0-2 | - | | | 30,700 | | | " |
| " " | Kokanee | 2-4 | - | 20,000 | 19,900 | 20,200 | | | " |
| Other Cascade Lakes | Brook trout | 2-4 | - | 86,400 | 30,300 | 32,800 | 26,300 | 33,500 | " |
| " " | Golden trout | 0-2 | - | | | 600 | | | " |
| " " | Rainbow | 2-4 | - | 2,200 | 10,000 | | 4,200 | 8,800 | " |
| " " | " | 4-6 | - | 32,500 | | | 1,000 | | " |
| " " | Cutthroat | 2-4 | - | | | | | 400 | " |
| Harriet Lake | Rainbow | 2-4 | - | 5,000 | 10,100 | | | | " |
| " " | " | 4-6 | - | 7,600 | | 8,800 | | | " |
| " " | " | 8 & over | - | 2,200 | | 1,000 | 4,000 | 7,300 | " |
| North Fork Res. | " | 2-4 | - | 110,100 | | | | | " |
| " " " | " | 4-6 | - | 72,100 | | | | | " |
| " " " | " | 8 & over | - | 26,900 | 8,700 | 23,500 | 11,100 | 24,000 | " |
| Timothy Lake | Brook trout | 2-4 | - | 102,300 | 50,000 | 25,000 | 26,000 | 25,100 | " |
| " " | Cutthroat | 0-2 | - | | 108,800 | 109,600 | 50,200 | | " |
| " " | " | 2-4 | - | | | | | 70,500 | " |
| " " | Kokanee | 0-2 | - | | | | 106,000 | 75,200 | " |
| " " | " | 2-4 | - | | 108,800 | 197,100 | 74,900 | 165,100 | " |
| " " | Rainbow | 0-2 | - | | 30,200 | | | | " |
| " " | " | 2-4 | - | 250,400 | 299,900 | 15,500 | | 100,300 | " |
| " " | " | 4-6 | - | | | 84,800 | 138,900 | 140,700 | " |
| " " | " | 8 & over | - | | 5,000 | | | | " |
| Faraday Lake | " | 4-6 | - | | | | | 17,100 | " |

**Table II-50**
*Minimum streamflow stipulations established by the Oregon State Water Resources Board*

| Stream | Location | Minimum Flows (cfs) |
|---|---|---|
| Clackamas River or tributaries | Upstream from USGS gage 14-2080 at Big Bottom | 150 (July 1-Sept. 15)<br>240 (Sept. 16-June 30) |
| Clackamas River or tributaries | Upstream from USGS gage 14-2095 | 400 (July 1-Augs.31) |
| Lowe Creek or tributaries | Upstream from mouth | 2 (July 1-Oct. 31)<br>8 (Nov. 1-June 30) |
| Pinhead Creek or tributaries | Upstream from mouth | 50 (June 1-Oct. 31)<br>75 Nov. 1-May 31) |
| Collawash River or tributaries | Upstream from mouth | 75 (July 16-Sept. 15)<br>250 (Sept. 16-May 31)<br>200 (June 1-July 15) |
| East Fork Collawash R. or tributaries | Upstream from mouth | 10 (Aug. 1-Sept. 30) |
| Elk Lake Creek or tributaries | Upstream from mouth | 15 (Aug. 1-Sept.30) |
| Hot Springs Fork Collawash River or tributaries | Upstream from mouth | 15 (July 16-Sept. 15)<br>75 (Sept. 16-July 15) |
| Oak Grove Fork Clackamas River or tributaries | Upstream from mouth | 10 (Aug. 1-Sept. 30) |
| Roaring River or tributaries | Upstream from mouth | 40 (July 1-Oct. 15)<br>100 (Oct. 16-June 30) |
| Fish Creek or tributaries | Upstream from mouth | 15 (July 1-Oct. 31)<br>60 (Nov. 1-June 30) |
| Wash Creek or tributaries | Upstream from mouth | 3 (July 16-Oct. 31)<br>25 (Nov. 1-June 15)<br>10 (June 16-July 15) |
| Eagle Creek or tributaries | Upstream from mouth | 40 (July 16-Oct. 31)<br>125 (Nov. 1-May 31)<br>100 (June 1-July 15) |
| North Fork Eagle Creek or tributaries | Upstream from mouth | 10 (Aug. 1-Oct. 31)<br>45 (Nov. 1-May 31)<br>30 (June 1-June 30)<br>20 (July 1-July 31) |
| Deep Creek or tributaries | Upstream from mouth | 10 (July 16-Oct. 31)<br>35 (Nov. 1-May 31)<br>20 (June 1-July 15) |
| North Fork Deep Creek or tributaries | Upstream from mouth | 1 (Aug. 1-Oct. 31)<br>20 (Nov. 1-May 31)<br>3 (June 1-July 31) |
| Tickle Creek or tributaries | Upstream from mouth | 4 (July 1-Oct. 31)<br>30 (Nov. 1-May 31)<br>6 (June 1-June 30) |
| Clear Creek or tributaries | Upstream from mouth | 20 (Aug. 1-Sept. 30)<br>40 (June 1-July 31) |
| Clear Creek or tributaries | Upstream from Viola, Oregon | 15 (July 16-Sept. 30)<br>25 (June 1-July 15) |

Table II-51

*Minimum flows for fish life recommended to Oregon State Water Resources Board by Oregon State Game Commission (cfs) 1/*

| Stream | Location | Dec.-May | June | July | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|
| Clackamas River | Downstream from River Mill Dam | 800 | 650 | 650 | 650 | 650 800 | 800 | 800 |
| " " | USGS gage 2095 (Three Lynx) | - | - | 400 | 400 | - | - | - |
| " " 2/ | USGS gage 2080 (Big Bottom) | 240 | 240 | 150 | 150 | 150 240 | 240 | 240 |
| Clear Creek | Mouth | 110 | 40 | 40 | 20 | 20 | 40 10 | 110 |
| " " | Viola | 70 | 25 | 20 15 | 15 | 15 | 25 40 | 70 |
| Collawash River | Mouth | 250 | 200 | 150 100 | 75 | 75 250 | 250 | 250 |
| E. Fk. Collawash R. | " | 30 | 30 | 20 15 | 10 | 10 | 15 20 | 30 |
| Elk Lake Creek | " | 40 | 40 | 30 20 | 20 15 | 15 | 20 30 | 40 |
| Hot Springs Fk. | " | 75 | 75 | 75 30 | 20 | 20 75 | 75 | 75 |
| Deep Creek | " | 35 | 20 | 10 | 10 | 10 | 12 | 35 |
| N. Fk. Deep Cr. | " | 20 | 3 | 3 | 1 | 1 | 1 3 | 20 |
| Tickle Creek | " | 30 | 6 | 4 | 4 | 4 | 4 6 | 30 |
| Eagle Creek | " | 125 | 100 | 100 50 | 40 | 40 | 40 | 125 |
| N. Fk. Eagle Cr. | " | 45 | 35 30 | 30 | 10 | 10 | 10 | 45 |
| Fish Creek | " | 60 | 60 | 25 15 | 12 | 12 | 12 15 | 60 |
| " " | Confl. of Wash Cr. | 30 | 16 12 | 8 5 | 3 | 3 | 8 . 16 | 30 |
| Wash Creek | Mouth | 25 | 25 10 | 10 5 | 3 | 3 | 10 20 | 25 |
| Lowe Creek | " | 8 | 8 8 | 3 2 | 2 | 2 | 2 | 8 |
| Oak Grove F. | " | 60 | 50 30 | 20 10 | 10 | 10 | 25 40 | 60 |
| Pinhead Cr. | " | 75 | 50 | 50 | 50 | 50 | 50 | 75 |
| Roaring River | " | 100 | 100 | 40 | 40 | 40 | 40 100 | 100 |
| S. Fk. Clackamas R. | " | 75 | 50 30 | 25 20 | 15 | 15 | 15 20 | 75 |

1/ *Where 2 figures are shown, minimums change during the month.*
2/ *The spawning flow listed is based on Oregon State Game Commission studies utilizing transects.*

## Present Economy

Each year Clackamas Subbasin provides an estimated 500 steelhead trout, 28,800 coho, and 12,500 spring chinook salmon to the commercial fisheries of Columbia River and Pacific Ocean. This 420,000 pound harvest is valued at $199,000 annually.

In 1965 an estimated 7,200 coho, 6,300 spring chinook salmon, and 900 steelhead trout of Clackamas Subbasin origin furnished 64,700 angler-days valued at $388,000 in the Clackamas River, Willamette River, Columbia River, and Pacific Ocean sport fisheries.

Clackamas River sport fisheries for sea-run cutthroat and steelhead trout, coho, and spring chinook salmon, extend from the mouth upstream to River Mill Dam. The steelhead fishery is large and is still growing. Seasonally, it extends from December into May. Coho angling takes place from October through December, and spring chinook angling occurs in April and May.

Stream trout fishing is supported mainly by hatchery-reared rainbow trout. Most of the trout are stocked in streams upstream from North Fork Reservoir. Access to these streams is easy, and angling intensity is heavy. Moderate angling effort is expended for resident cutthroat in the upper portions of most streams. An estimated 173,500 angler-days valued at $520,000 are expended annually on stream trout in the subbasin.

The Cascade lakes and Timothy, North Fork, Harriet, and Faraday Reservoirs receive considerable angling pressure. This pressure, however, is less than the total exerted upon streams. Stocked rainbow trout make up the bulk of the catch from the reservoirs. Significant numbers of cutthroat trout and kokanee are also taken in Timothy Lake, the largest and most heavily fished impoundment. Brook trout is the species most frequently caught in the Cascade lakes. The lakes and reservoirs of the subbasin support a sport fishery estimated to total 160,000 angler-days valued at $320,000 annually.

## SUBBASIN 10 - COLUMBIA

Major streams in Columbia Subbasin are Scappoose and Milton Creeks, tributaries of Columbia River; and Johnson, Kellogg, and Oswego Creeks, tributaries of Willamette River (Map II-10). Other important areas are Oswego Lake and numerous sloughs and floodplain lakes along Columbia River, including those of Sauvie Island northwest of Portland.

### Habitat

Streams in the subbasin are few in number and relatively small in size. They all drain low-elevation watersheds and are often incapable of providing flows of adequate quality or quantity for salmonid rearing in summer. Effects of dense human population in the area, principally those depleting water quality and quantity, further reduce fish populations in many streams. In late summer, flows in the two largest stream systems, Johnson and North Fork Scappoose Creeks, commonly drop near to 2 and 5 cubic feet per second, respectively. Water temperatures in lower portions of streams in the subbasin frequently range between 65° and 75°F in the summer. These temperatures approach critical levels for salmon and trout; consequently, most rearing takes place in the upper stream areas where the water is cooler. A notable exception is Crystal Springs Creek, a short, spring-fed tributary of lower Johnson Creek that discharges between 14 and 20 cfs at a temperature of less than 65°F in most summer periods.

Warm water temperatures that prevail in most of the subbasin's non-stream water areas favor the production of warm-water game fish, but are also favorable for nongame fish such as carp and squawfish. Water temperatures in the lakes are so warm that stocked trout cannot survive to provide angling.

### Species and Distribution

Despite the limitations in stream habitat, significant numbers of anadromous fish are produced in the Johnson, Scappoose, Milton, and Kellogg Creek drainages. Map II-10 shows the anadromous fish distribution. Average annual spawning populations of 1,100 coho salmon and an equal number of winter steelhead trout are estimated to use these systems. Substantial but undetermined numbers of sea-run cutthroat trout enter the subbasin streams to spawn. Fall chinook salmon, usually less than 100, spawn in lower Scappoose Creek, while sporadic runs of chum salmon, usually less than 200, spawn in Milton Creek. Low streamflows during fall chinook and chum salmon spawning periods are largely responsible for the small runs of these species.

Resident cutthroat trout occur in moderate to high numbers in upper sections of streams where summer water quantity and quality are best. Rainbow or cutthroat trout are stocked each year in Johnson Creek, Milton Creek, and both forks of Scappoose Creek.

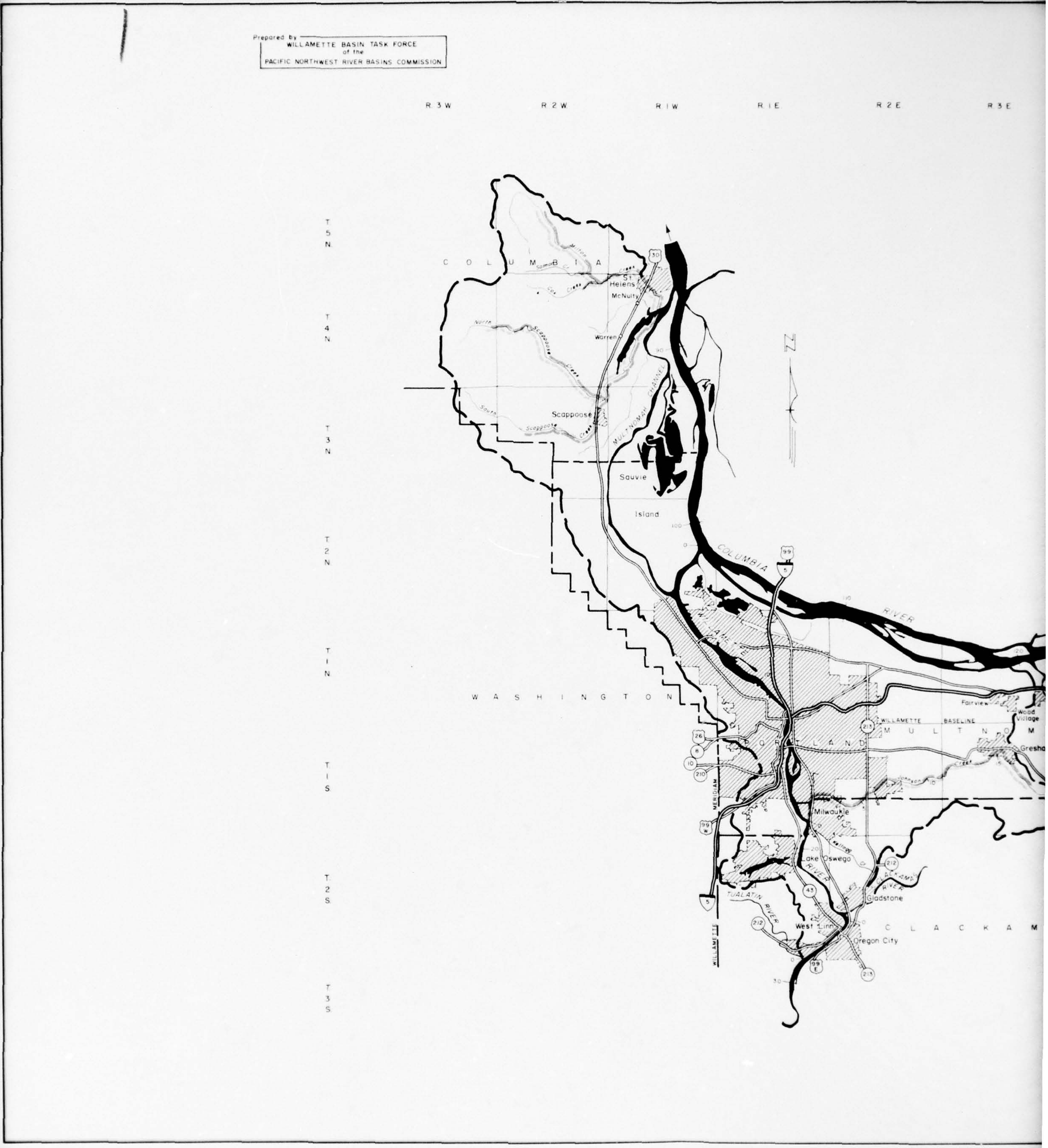
*Photo II-38. Yellow perch, an introduced panfish, inhabit most warm-water habitat in the basin. (R. J. Fischer photo)*

Mixed populations of 12 species of warm-water game fish and at least 13 species of nongame fish are widespread in the slough and lake areas along Columbia River. Many of these fish are also present in 400-acre Oswego Lake, immediately south of Portland.

Developments and Conditions Adversely Affecting Fish Resources

Poor water quality affects fish in lower Scappoose Creek (Scappoose Bay). This large slough-like area at the mouth of Scappoose and Milton Creeks joins Columbia River at St. Helens. Kaiser Gypsum softboard plant contributes organic wastes to the bay. Low dissolved oxygen concentrations which affect salmonids in Scappoose Bay are caused primarily by organic effluents from this plant. Toxic substances occasionally kill fish in the area. Pollution commonly prevents or delays entry of anadromous fish into Scappoose and Milton Creeks. A Boise Cascade Corporation pulp and paper plant that discharges wastes into Multnomah Channel may also adversely affect fish in this general area.

Low streamflows that occur naturally in summer months are further reduced by consumptive water uses. Surface water rights for consumptive use in the major fish-producing stream systems total more than summer flows (Table II-52). The consumptive water rights on Johnson and Kellogg Creeks are mainly for municipal use. Although the water rights commonly exceed discharges in the low flow seasons, unused water, seepage, or tributary accretion prevent complete drying of most streams.


Prepared by
WILLAMETTE BASIN TASK FORCE
of the
PACIFIC NORTHWEST RIVER BASINS COMMISSION
R.3W
R.2W
R.1W
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R.2E
R.3E
T.5N.
T.4N.
T.3N.
T.2N.
T.1N.
T.1S.
T.2S.
T.3S.
COLUMBIA
St. Helens
McNulty
Warren
Scappoose
MULTNOMAH CHANNEL
Sauvie
Island
COLUMBIA
RIVER
WASHINGTON
PORTLAND
WILLAMETTE BASELINE
Fairview
Wood Village
Milwaukie
Lake Oswego
Gladstone
West Linn
Oregon City
TUALATIN RIVER
WILLAMETTE MERIDIAN

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2

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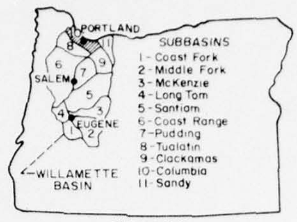
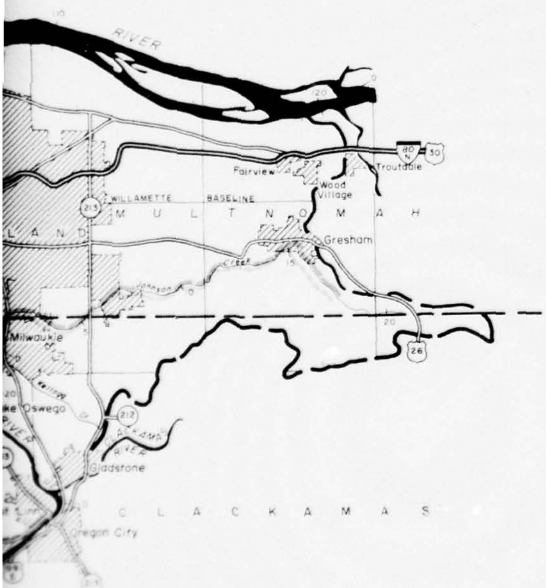



KEY MAP
SHOWING SUBBASINS




LEGEND
Present distribution (May, 1966)
STEELHEAD
COHO

MAP II - 10
COLUMBIA SUBBASIN
WILLAMETTE BASIN, OREGON

ANADROMOUS FISH DISTRIBUTION

APRIL 1967

3 0 3 6
SCALE IN MILES

WBTF-10-1172d-LL

Table II-52

*Appropriated surface water and minimum streamflow measurement data, Columbia Subbasin (cfs)*

| Stream Area | Appropriated Surface Water 1/ | | Instantaneous Minimum Flows Measured | | | |
|---|---|---|---|---|---|---|
| | Non-Consumptive | Consumptive | Instantaneous Discharge | Location | Date 2/ | Source 2/ |
| Johnson Creek System | 6.9 | 7.7 | 0.2 | River mile 10.2 | Portions of 4 yrs. (1940-1967) | USGS |
| Kellogg Creek System | 21 | 2.6 | - | - | | - |
| Milton Creek System | 0.3 | 72 | 4 | Mile 1.0 | Sept. 11, 1962 | OSGC |
| Scappoose Creek | - | - | - | - | - | - |
| North Fork Scappoose Creek | 0.02 | 4.2 | 5 | Hwy. 30 crossing | Sept. 11, 1962 | OSGC |
| South Fork Scappoose Creek | 0.1 | 22 | 3 | Near mouth | Sept. 11, 1962 | OSGC |
| Other streams exclusive of Willamette R. & Multnomah Channel | 3.2 | 114 | - | - | - | - |
| Scappoose Bay | 3.7 | 4.4 | - | - | - | - |
| Multnomah Channel | 2.0 | 103 | - | - | - | - |

1/ *Oregon State Water Resources Board records, April 1966.*
2/ *U. S. Geological Survey period of available records is shown in parenthesis. Oregon State Game Commission listings are the lowest of flows measured monthly in low discharge periods of 1962 and 1963.*

Photo II-39. *Lake Oswego outlet dam and Oswego Creek. (Oregon State Game Commission photo)*

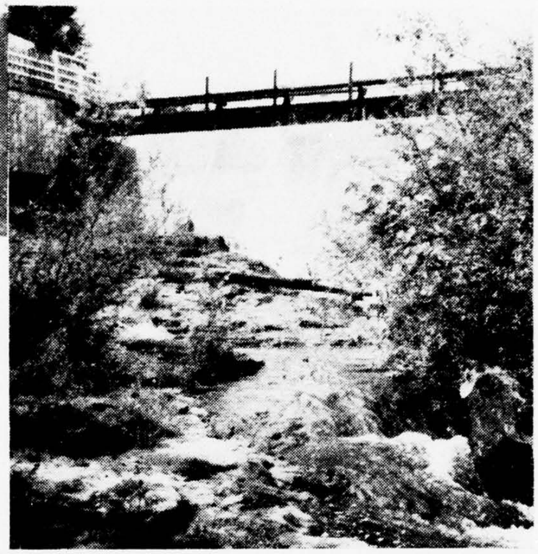


Photo II-40. *Oswego Creek Falls. (Oregon State Game Commission photo)*

The 20-foot dam forming Oswego Lake is located just above a waterfall, also 20 feet high (Photos II-39 and 40). Neither barrier is provided with fish-passage facilities. The dam and falls provide head for a powerplant that receives portions of the lake outflow at a point a short distance downstream from the falls. Large amounts of Tualatin River water are diverted by a 2-mile-long canal into Oswego Lake for eventual use at the powerplant.

Adult coho and steelhead bound for Tualatin River are attracted by Tualatin River water into Oswego Creek, the lake outlet. The 0.1-mile section of the creek below the 20-foot falls has only limited spawning area. In recent years attempts have been made to alleviate the problem by capturing the fish and planting them elsewhere, and eliminating the spill when the fish are running. However, a better solution would be to prevent the fish from entering the creek.

Diversion of juvenile anadromous fish into Oswego Lake via the unscreened canal is an associated problem. These fish are subject to predation by high populations of nongame and warm-water game fish in the lake, and to injury and mortality inflicted at the powerhouse below the lake.

*Photo II-41. Lake Oswego supports large populations of warm-water game and non-game fish, but there is no public access. (Oregon State Highway Department photo)*

The City of Scappoose has a municipal water supply dam on Gourlay Creek, 0.7 mile upstream from its mouth. The dam is 5 feet high and has no fish ladder. It blocks the migration of trout and salmon to 2 miles of stream habitat. The diversion is unscreened. Another dam for the City of Scappoose municipal water supply is located on South Fork of Scappoose Creek near stream mile 6.5. This one has a passable fish ladder.

## Developments Beneficial to Fish Resources

A concrete fish ladder was constructed in 1951 over 20-foot high "Bonnie Falls" on North Fork of Scappoose Creek 4.5 miles upstream from its mouth.

Anadromous fish and trout liberations into waters of the subbasin in the 1961-1965 period are given in Table II-53. The subbasin contains four private stocked fish ponds but these are not normally open to the public unless operated on a fee basis.

Table II-54 shows minimum flow stipulations established for the subbasin by the Oregon State Water Resources Board. These stipulations substantially limit future water appropriations from natural flows of the listed stream areas and should greatly aid in protecting fish resources.

Minimum streamflows recommended by the Game Commission for this subbasin are listed in Table II-55.

Table II-53
*Numbers of fish stocked in Columbia Subbasin, 1961-1965*

| Stream System | Species | Mean Length (Inches) | Number per pound | 1961 | 1962 | 1963 | 1964 | 1965 | Agency |
|---|---|---|---|---|---|---|---|---|---|
| Johnson Creek | Steelhead | Yearling | - | 17,000 | | | | | OSGC |
| " " | Rainbow | 8 & over | - | 2,000 | 2,000 | 2,000 | 3,100 | 2,000 | " |
| Milton Creek | Steelhead | Yearling | - | | | | 15,200 | | " |
| " " | " | 2-4 | - | | 10,300 | | | | " |
| " " | " | 4-6 | - | | | 5,000 | | 30,000 | " |
| " " | Cutthroat | 8 & over | - | | 4,900 | 4,000 | 2,000 | | " |
| " " | Rainbow | " " | - | 3,000 | 2,000 | 1,000 | 1,000 | 2,000 | " |
| Scappoose Creek | Steelhead | Yearling | - | | | | 16,800 | | " |
| " " | " | 2-4 | - | | 20,500 | | | | " |
| " " | " | 4-6 | - | | | 5,000 | | 30,000 | " |
| " " | Cutthroat | 8 & over | - | 4,000 | 5,000 | 5,000 | 2,000 | | " |
| " " | Rainbow | " " | - | 1,000 | 1,000 | 1,000 | 1,000 | 2,000 | " |

Table II-54
*Minimum streamflow stipulations established by the Oregon State Water Resources Board*

| Stream | Location | Minimum Flows (cfs) |
|---|---|---|
| Milton Creek or tributaries | Upstream from Salmon Creek | 25 (Nov. 1-Apr. 30) |
| Cox Creek or tributaries | Upstream from mouth | 6 (Nov. 1-Apr. 30) |
| Salmon Creek or tributaries | Upstream from mouth | 5 (Nov. 1-Apr. 30) |
| North Scappoose Cr. or tributaries | Upstream from mouth | 5 (July 16-Oct. 31)<br>40 (Nov. 1-May 31)<br>20 (June 1-July 15) |
| Alder Creek or tributaries | Upstream from mouth | 1 (July 1-Oct. 31)<br>8 (Nov. 1-May 31)<br>3 (June 1-June 30) |
| Cedar Creek or tributaries | Upstream from mouth | 1 (July 1-Oct. 31)<br>6 (Nov. 1-May 31)<br>3 (June 1-June 30) |
| Chapman Creek or tributaries | Upstream from mouth | 1 (July 1-Oct. 31)<br>6 (Nov. 1-May 31)<br>3 (June 1-June 30) |
| North Fork of N. Fk. Scappoose Creek or tributaries | Upstream from mouth | 1 (July 16-Oct. 31)<br>7 (Nov. 1-May 31)<br>3 (June 1-July 15) |
| Sierkes Creek or tributaries | Upstream from mouth | 0.5 (June 16-Oct. 31)<br>7 (Nov. 1-June 15) |
| South Fork of North Scappoose Creek or tributaries | Upstream from mouth | 1 (July 1-Oct. 31)<br>8 (Nov. 1-May 31)<br>4 (June 1-June 30) |
| South Scappoose Creek or tributaries | Upstream from Raymond Creek | 5 (July 1-Oct. 31)<br>25 (Nov. 1-May 31)<br>12 (June 1-June 30) |
| Gourlay Creek or tributaries | Upstream from mouth | 0.5 (July 16-Oct. 31)<br>10 (Nov. 1-May 31)<br>2 (June 1-July 15) |
| Raymond Creek or tributaries | Upstream from mouth | 0.5 (July 16-Oct. 31)<br>8 (Nov. 1-May 31)<br>1 (June 1-July 15) |

Table II-55

*Minimum flows for fish life recommended to Oregon State Water Resources Board by Oregon State Game Commission (cfs) 1/*

| Stream | Location | Dec.-May | June | July | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|
| Small streams tributary to Scappoose Bay | | | | | | | | |
| Milton Creek | Confl. of Salmon Cr. | 25 | 10 8 | 5 4 | 3 | 3 | 3 5 | 25 |
| Cox Creek | Mouth | 6 | 3 2 | 1 0.5 | 0.5 | 0.5 | 0.5 1 | 6 |
| Salmon Creek | " | 5 | 1 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 5 |
| N. Fk. Scappoose Cr. | " | 40 | 25 20 | 20 8 | 5 | 5 | 5 7 | 40 |
| Alder Creek | " | 8 | 3 | 1 | 1 | 1 | 1 | 8 |
| Cedar Creek | " | 6 | 3 | 1 | 1 | 1 | 1 | 6 |
| Chapman Cr. (Lizzie Cr.) | " | 6 | 4 3 | 2 | 1 | 1 | 1 | 6 |
| N. Fk. of N. Fk. | "(Joins S. Fk. of N. Fk. 0.2 mi. upstream from Mollenhear Cr.) | 7 | 4 3 | 3 1 | 1 | 1 | 1 2 | 7 |
| Sierkes Cr. (Deep Cr.) | Mouth | 7 | 7 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 7 |
| S. Fk. of N. Fk. | " | 8 | 4 3 | 2 1 | 1 | 1 | 1 2 | 8 |
| S. Fk. Scappoose Cr. | Confl. of Raymond Cr. | 25 | 15 12 | 5 | 5 | 5 | 5 6 | 25 |
| Gourlay Cr. | Mouth | 10 | 3 2 | 2 0.5 | 0.5 | 0.5 | 0.5 1 | 10 |
| Raymond Cr. | " | 8 | 2 1 | 1 0.5 | 0.5 | 0.5 | 0.5 1 | 8 |
| Small streams tributary to Willamette River | | | | | | | | |
| Johnson Creek | USGS Gage 2115 | 25 | 5 4 | 4 | 4 | 4 | 4 5 | 25 |
| Crystal Springs | Mouth | 15 | 10 | 10 | 10 | 10 | 10 | 15 |

1/ *Where 2 figures are shown, minimums change during the month.*

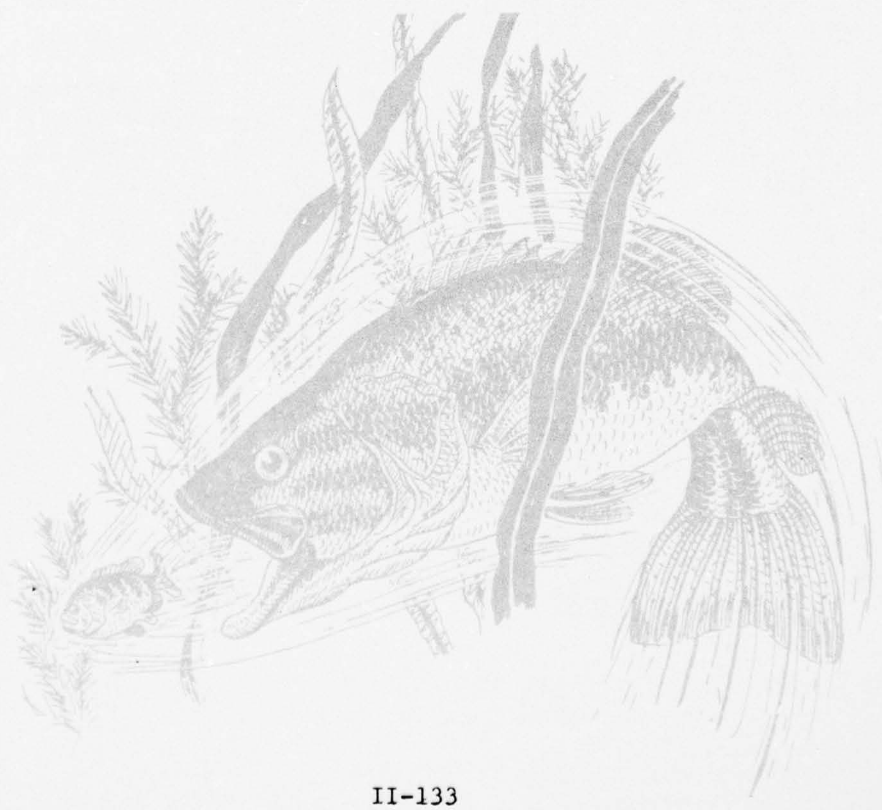
## Present Economy

Anadromous fish originating in the subbasin's streams furnish an estimated 2,600 coho and 100 steelhead to the commercial fisheries of Columbia River and Pacific Ocean. This represents a catch of 19,000 pounds of fish valued at $7,500 annually.

Sport angling pressure for coho and steelhead in Johnson, Scappoose, Milton, and Oswego Creeks, the only streams open to winter fishing, is high compared to streams of similar size elsewhere in Willamette Basin. A large percentage of the angling is conducted by youngsters living nearby. An estimated 700 coho and 200 steelhead produced in these streams are harvested there and in Willamette and Columbia Rivers and Pacific Ocean sport fisheries. Salmon and steelhead produced in this subbasin furnish an estimated 2,000 fisherman-days valued at $12,000 annually.

Trout angling is usually heavy and is mainly supported by hatchery fish liberated in Johnson, Scappoose, and Milton Creeks. This fishery furnishes approximately 20,000 days fishing valued at $60,000 annually.

Intensive fishing pressure is exerted throughout the year upon warm-water game fish. This fishery has a substantial, but unknown, monetary value. The waters of Sauvie Island receive by far the greatest angler concentrations (Map II-10). Species caught in greatest abundance are white crappie, black crappie, bullhead catfish, largemouth bass, yellow perch, and bluegill sunfish.



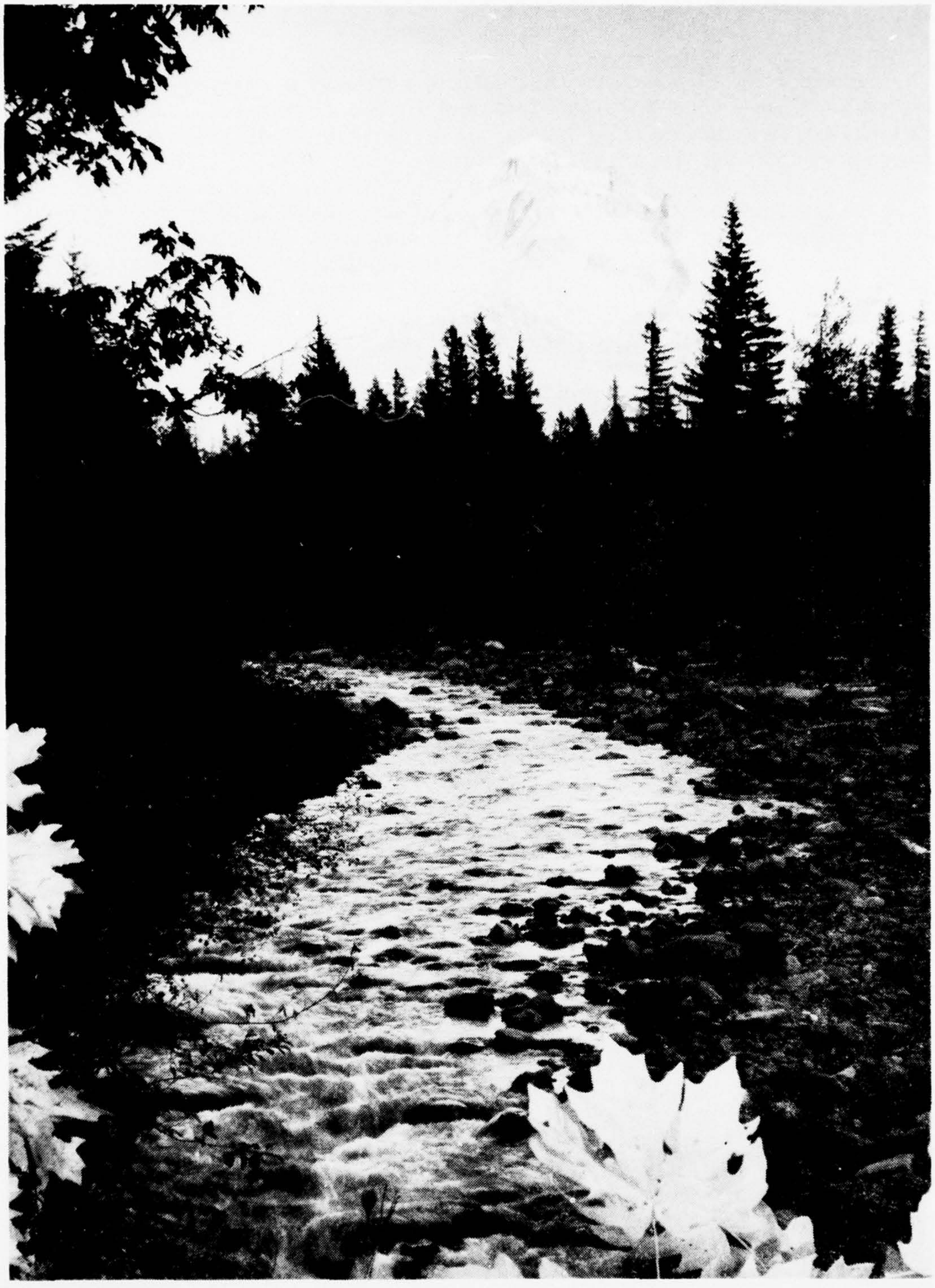


*Photo II-42. Salmon River a principal tributary of the Sandy River. (Oregon State Highway Department photo)*

## SUBBASIN 11 - SANDY

Sandy River system, plus nine small Columbia River tributaries between the mouth of Sandy River and Bonneville Dam, comprise the streams of the subbasin (Map II-11). Important nonstream waters include slough areas along the Columbia River, at least 14 high mountain lakes, and three low-elevation lakes. Two of the latter, Benson and Wahkeena, are lakes created by high flows in Columbia River. Each is approximately 20 surface acres in size and both have become better stabilized by the Columbia River Highway (Interstate 80N) which now protects them from high river flows. The third low-elevation lake, Roslyn, is a Portland General Electric Company reservoir located near the confluence of the Sandy and Bull Run Rivers. It is 160 acres in size and stores water for use in Bull Run Powerhouse situated on Bull Run River 1.5 miles upstream from its mouth.

### Habitat

Most subbasin streams provide favorable habitat for the spawning and rearing of salmon and trout. All major streams arise from well-forested watersheds on the western slope of Mount Hood and the Cascade Range. Sandy River is 55 miles long and drains 508 square miles. Stream shading is generally good, which helps keep the water cold. Water temperatures in streams other than the lower Sandy River seldom exceed 65°F. Summer water temperatures of the lower Sandy generally range between 55° and 70°F. and have been recorded as high as 71°F. Sandy River discharge averages more than 2,400 cubic feet per second. If the river were not regulated for power and municipal water supply purposes, flows would seldom drop to less than 400 cfs at the mouth. However, these water uses frequently cause the flow at the river mouth to drop to less than 100 cfs during the summer.

Large amounts of glacial silt from Mount Hood enter the river during warm summer periods giving the water a milky color. The Sandy was named for the enormous quantity of sand that washes from the slopes of Mount Hood and settles on the bottom of the river, particularly in the lower 10 miles. These sand deposits reduce spawning and rearing area for salmon and trout.

Sandy River enters the Columbia directly; consequently, anadromous fish runs are not subject to the pollution problems of the Willamette system.

### Species and Distribution

The Sandy River system supports natural spawning populations of 2,200 coho salmon, 5,000 winter steelhead trout, 1,000 fall chinook salmon, and 800 spring chinook salmon annually. Fish spawning in the nine Columbia River tributaries, excluding hatchery runs, totals 200 coho, 100 winter steelhead and 100 fall chinook. The contribution of hatcheries is discussed in the section "Developments Beneficial to Fish Resources." The distribution of anadromous fish is illustrated in Map II-11.

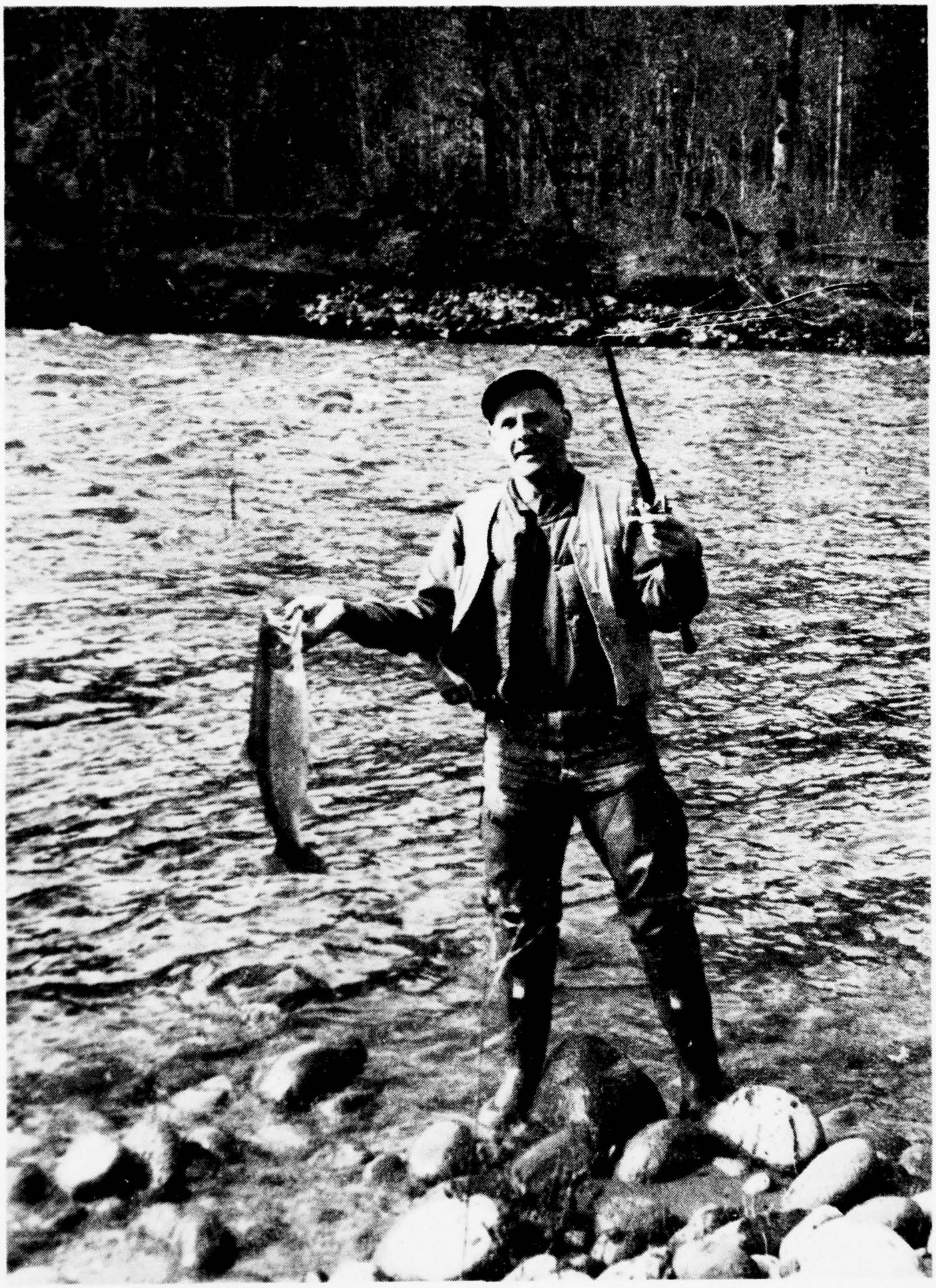


Photo II-43. A Sandy River steelhead. (Oregon State Game Commission photo)

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WILLAMETTE BASIN TASK FORCE
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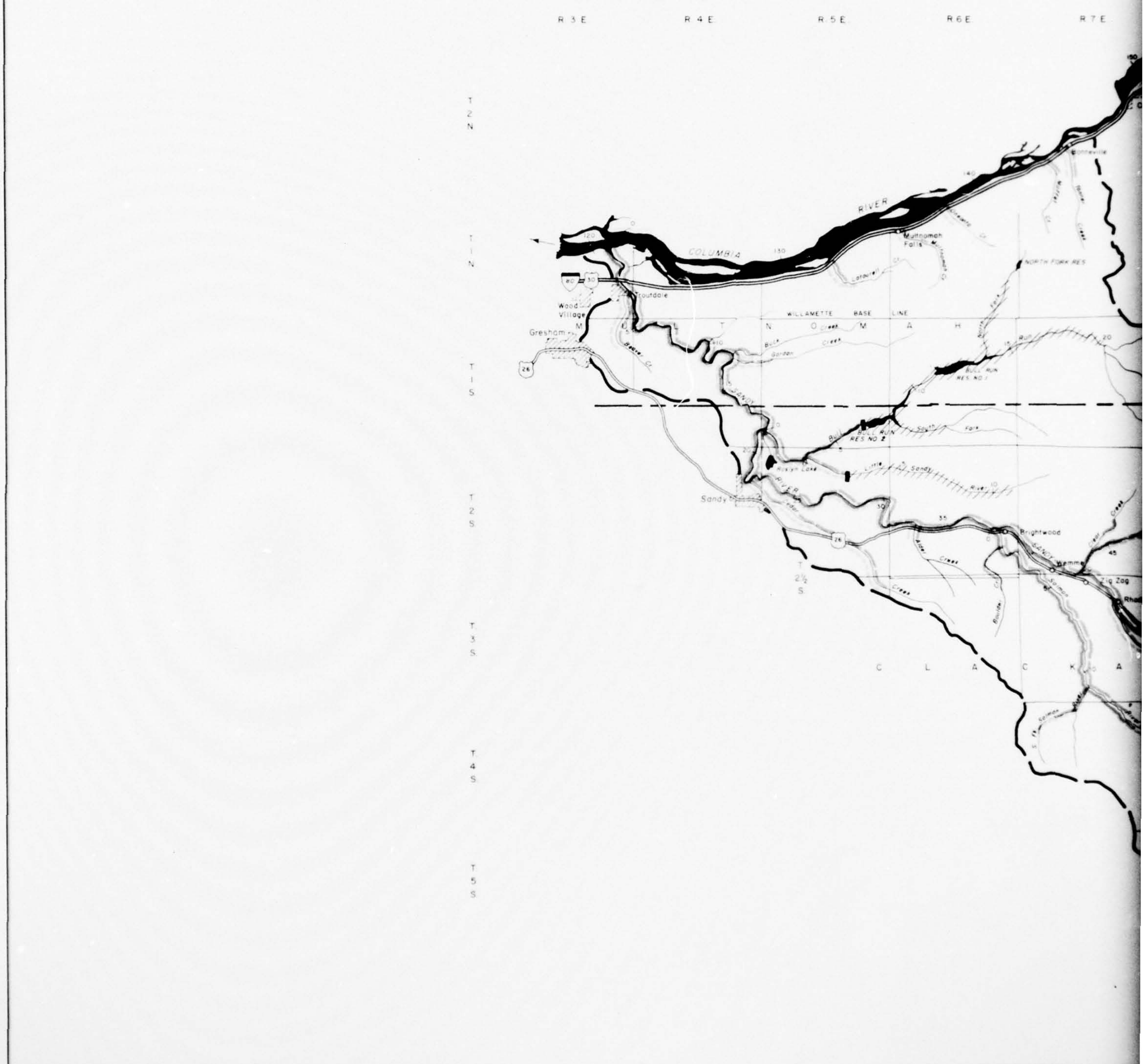
PACIFIC NORTHWEST RIVER BASINS COMMISSION



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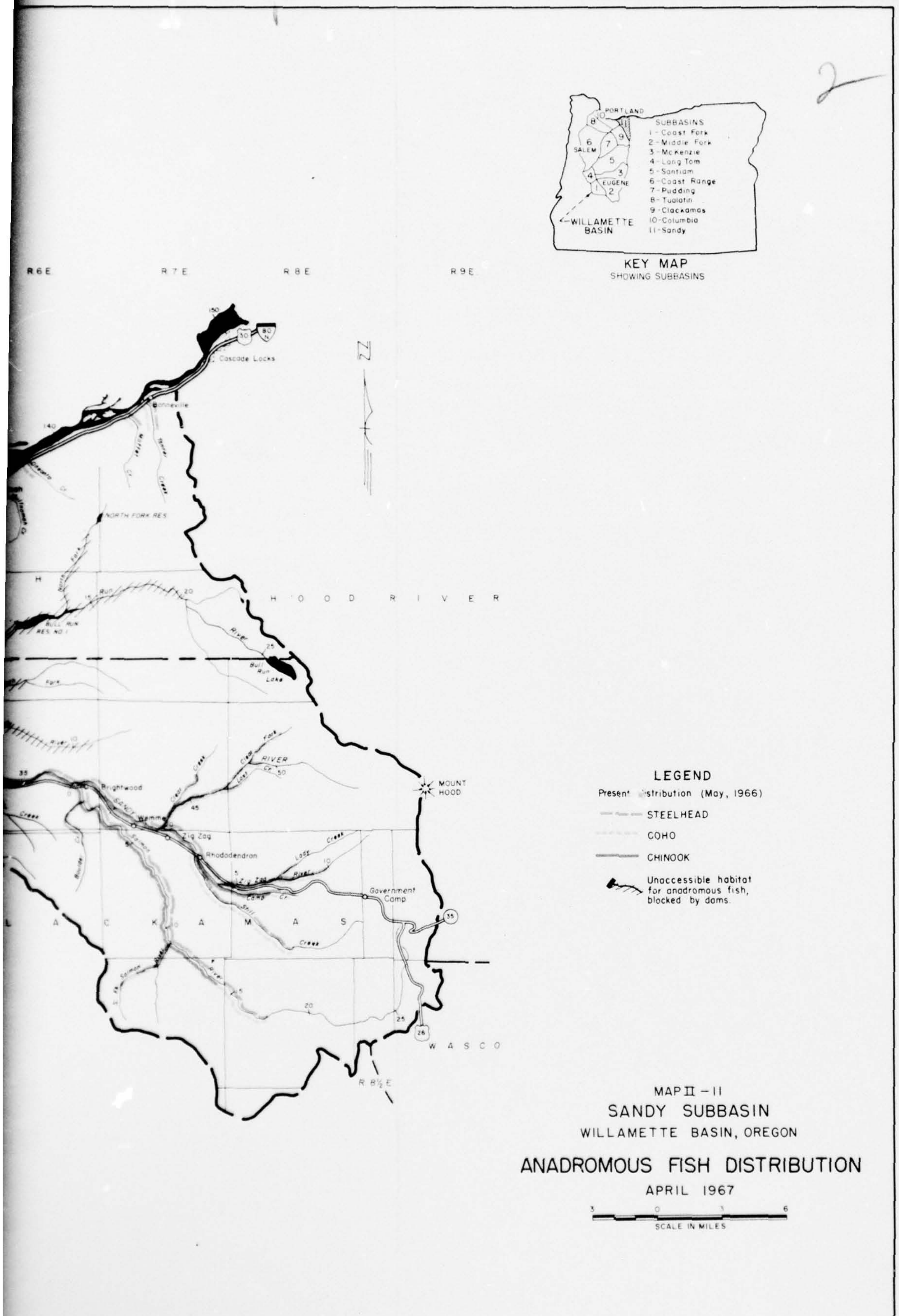


MAP II - 11
SANDY SUBBASIN
WILLAMETTE BASIN, OREGON
ANADROMOUS FISH DISTRIBUTION
APRIL 1967

WBTF-11-1173d-LL

Total counts of spring chinook and winter steelhead that ascend Marmot Dam, located at river mile 30 on Sandy River, have been made since 1954 with a trap or electronic counter in the fish ladder. Coho salmon counts began in 1958. These counts are shown in Table II-56. Fall chinook salmon are not included in the table since almost all this run spawns below Marmot Dam. There is a remnant run of summer steelhead in Bull Run River, a large Sandy River tributary entering at river mile 18.5. Prior to 1952, small numbers of chum salmon were recorded in Beaver Creek, a tributary entering Sandy River near Troutdale.

Table II-56
*Marmot Dam fish counts, Sandy Subbasin*

| Migratory Season | Steelhead | Coho | Spring Chinook |
|---|---|---|---|
| 1953-54 | 2,200 | 1/ | 400 |
| 1954-55 | 1,581 | 1/ | 5 |
| 1955-56 | 2,240 | 1/ | 0 |
| 1956-57 | 2,054 | 1/ | 10 |
| 1957-58 | 3,166 | 264 | 78 |
| 1958-59 | 2,359 | 330 | 304 |
| 1959-60 | 1,612 | 68 | 23 |
| 1960-61 | 3,124 | 1,670 | 37 |
| 1961-62 | 4,046 | 1,769 | 65 |
| 1962-63 | 3,326 | 1,458 | 122 |
| 1963-64 | 3,893 | 2,198 | 660 |

1/ *Records not available.*

Sandy River has long been Oregon's main producer of Columbia River smelt or eulachon. Smelt frequently have not entered the Sandy for periods of one to several years, and there has been no run since 1957, the longest recorded absence. Table II-57 lists data available on smelt runs since 1919.

AD-A036 749 PACIFIC NORTHWEST RIVER BASINS COMMISSION VANCOUVER WASH F/G 8/6
THE WILLAMETTE BASIN COMPREHENSIVE STUDY OF WATER AND RELATED L--ETC(U)
1969

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A036 749

Table II-57

*Sandy River smelt run data, 1919-1966 1/*

| Year | Run Started | Run Ended | Remarks |
|---|---|---|---|
| 1919 | March 29 | - | Large run of fish. |
| 1920 | No run | - | |
| 1921 | No run | - | |
| 1922 | April 11 | - | Second run began on April 17. |
| 1923 | April 4 | - | Very light because of obstruction in Sandy River. |
| 1924 | March 28 | - | Channel still blocked. |
| 1925 | March 14 | April 4 | One of longest runs. Fish Commission transferred some smelt to Clackamas R. |
| 1926 | March 12 | - | 50,000 people out. |
| 1927 | March 28 | - | Poor run. |
| 1928 | March 12 | - | |
| | | | Number of Licenses Sold |
| 1929 | April 9 | - | 793 |
| 1930 | March 18 | - | 5,786 |
| 1931 | No run | - | - |
| 1932 | March 26 | - | 193 |
| 1933 | No run | - | - |
| 1934 | March 4 | - | 1,860 |
| 1935 | No run | - | - |
| 1936 | March 27 | April 8 | 2,536 |
| | | | Also ran heavily in Columbia R. at mouth of Tanner and Eagle Creeks |
| 1937-39 | No runs | - | - |
| 1940 | March 6 | March 18 | 2,760 |
| 1941 | March 14 | March 24 | 2,775 |
| 1942 | March 19 | April 1 | 7,699 |
| 1943 | March 25 | April 1 | 6,596 |
| 1944 | No run | - | - |
| 1945 | April 1 | April 15 | 17,754 |
| 1946 | March 28 | April 8 | 19,725 |
| 1947 | No run | - | - |
| 1948 | March 27 | April 11 | 32,422 |
| 1949 | March 24 | April 9 | 42,612 |
| 1950 | No run | - | - |
| 1951 | April 5 | April 10 | 25,650 |
| 1952 | - | - | 1,960 |
| 1953 | April 19 | April 29 | 59,503 |
| 1954 | April 1 | April 7 | 11,662 |
| 1955 | No run | - | - |
| 1956 | March 29 | April 10 | 34,288 |
| 1957 | March 26 | April 1 | 26,690 |
| 1958-66 | No runs | - | - |

*1/ Source: Oregon State Game Commission*

*Photo II-44. A smelt run on the Sandy River. (Oregon State Highway Department photo)*

Large numbers of shad enter the lower river each spring on their spawning run. Resident cutthroat trout inhabit subbasin streams. The largest populations are located in the headwaters. Sea-run cutthroat trout in undetermined but significant numbers spawn in Sandy Subbasin. Whitefish are common in the larger streams and brown trout are caught occasionally. Both rainbow and brook trout inhabit the small Cascade lakes. Benson and Roslyn Lakes are stocked with rainbow trout each year.

Warm-water game fish are restricted to Columbia River and its slack water areas. Dace, Pacific lamprey, and sculpins are the only nongame species known to be present in the subbasin streams. Nongame species common in Columbia River, such as suckers, and squawfish, probably enter the lower Sandy River system, but their numbers and distribution are limited by cold water.

### Developments and Conditions Adversely Affecting Fish Resources

Three prominent dams have varying effects upon salmonid production. Largest of the three is Marmot Dam, a concrete and wood structure 30 feet high, which was constructed on the Sandy River in 1912. This Portland General Electric Company installation diverts up to 600 cfs of water through a system of canals and tunnels to Roslyn Lake where it eventually drops through Bull Run Powerhouse to lower Bull Run River (Figure II-6).

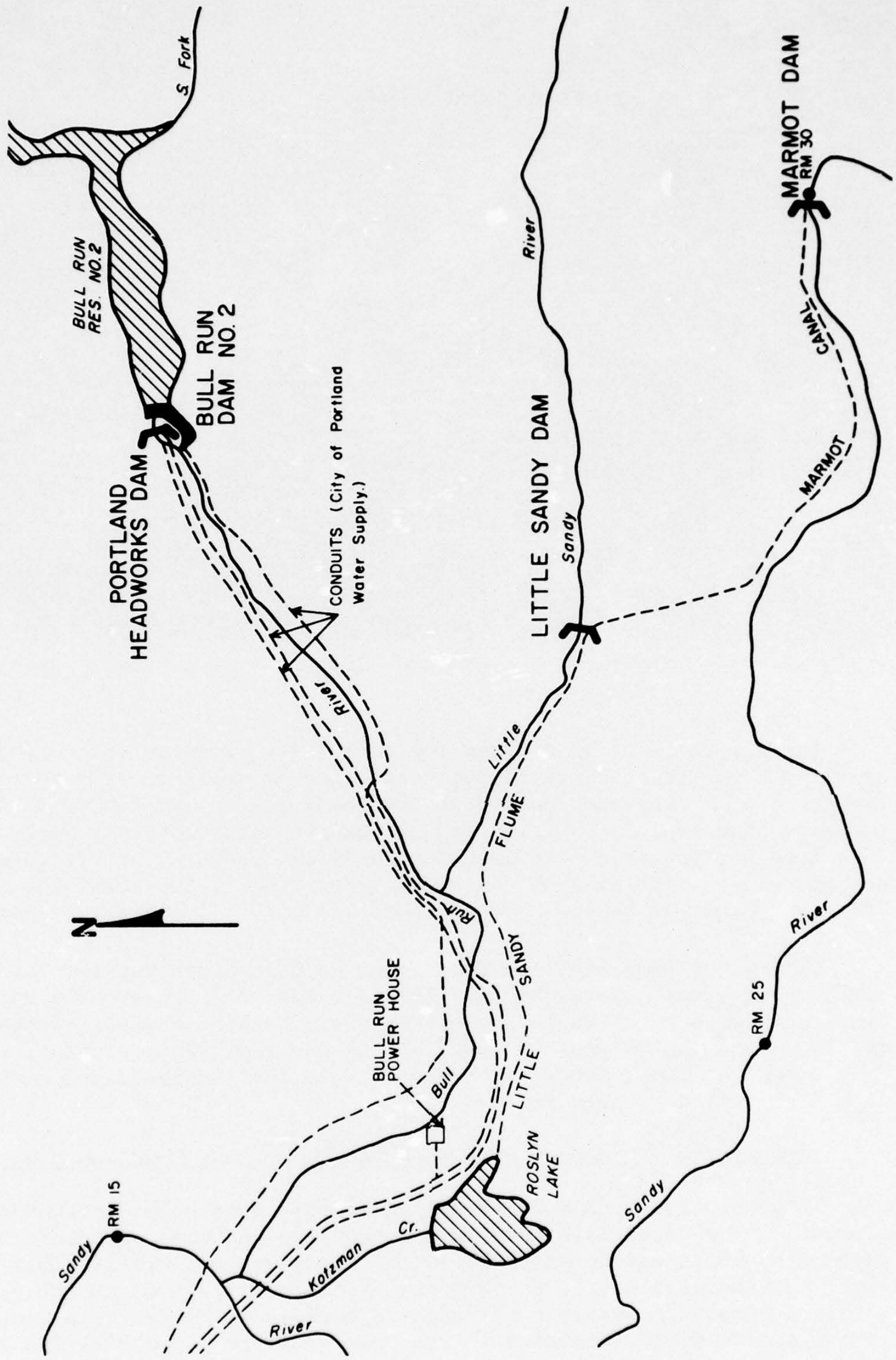



*Figure II-6. Sketch of Sandy River diversion network.*

In summer and fall, the volume of Sandy River water diverted at Marmot Dam far exceeds that passing over the dam. Resulting low flows between the dam and the mouth of Bull Run River, 11.5 miles downstream, reduce rearing, interfere with spawning, and retard upstream migration of anadromous fish. Flows through this section often fall below 50 cfs in the summer and fall. In lowest discharge months, the flow arriving at Marmot Dam usually is between 300 and 400 cfs.

Some of the river's best summer resting pools for adult spring chinook salmon are in the canyon below Marmot Dam. Spring chinook, fall chinook, and coho salmon attempt to spawn or migrate through the area in late summer and autumn before there has been sufficient rainfall to increase flows. Salmon and steelhead pass upstream through the fish ladder at the dam, but their migration is probably delayed slightly.

The second major dam affecting fish, Little Sandy Dam, is an unladdered, concrete structure on Little Sandy River 1.7 miles above its mouth. It blocks salmon and steelhead from more than 4.5 miles of spawning and rearing habitat. The 15-foot dam is owned by Portland General Electric Company. Little Sandy River enters Bull Run River at mile 2.9. At Marmot Dam on Sandy River, water is diverted into a canal that enters a tunnel and discharges into Little Sandy River about 75 yards upstream from Little Sandy Dam. Little Sandy Dam diverts water from both Marmot canal and Little Sandy River into another canal leading to Roslyn Lake. The Company attempts to stop flow below Little Sandy Dam. As a result, few anadromous fish are attracted to this barrier except during high flows when some spilling is unavoidable.

Power peaking operations at Bull Run Powerhouse, especially in the low flow periods of summer and fall, cause severe daily fluctuations in the flow of Sandy River. Diurnal discharges in the 18.5-mile section of the Sandy below its confluence with Bull Run River vary as much as eightfold. Extremes of 100 to 855 cfs, measured October 11, 1963 at river mile 5 during a time of active chinook salmon spawning, typify the range of daily flow fluctuations. Since 1929, the lowest flow recorded at the U. S. Geological Survey gage 1 mile below the mouth of Bull Run River was 45 cfs on September 26, 1962. Discharges approaching this rate occur frequently and are wholly inadequate for fish migration and spawning. The large fluctuations in flow also strand fish, impede migration, encourage poaching, and generally impair fish production.

The third dam affecting salmonids is the City of Portland's headworks dam at river mile 6.2 on Bull Run River (Photos II-45, II-46). It is approximately 20 feet high and diverts municipal water to the City of Portland (Figure II-6). The dam is unladdered and thus is the upstream limit of anadromous fish in Bull Run River. Water permitted to flow past the headworks dam dwindles to almost nothing in late summer. Two storage dams, Bull Run No. 2 and Bull Run No. 1 are 0.1 mile and 4.8 miles farther upstream, respectively.

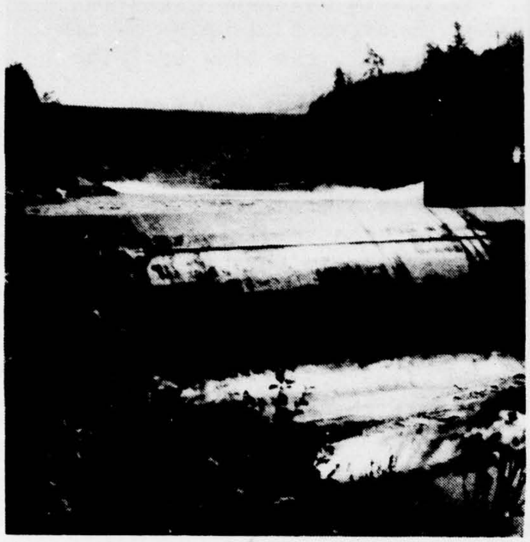


*Photo II-45. Portland headworks dam on Bull Run River.*

*Photo II-46. Flow below headworks dam.*

*Photo II-47. Bull Run Reservoir Dam.*

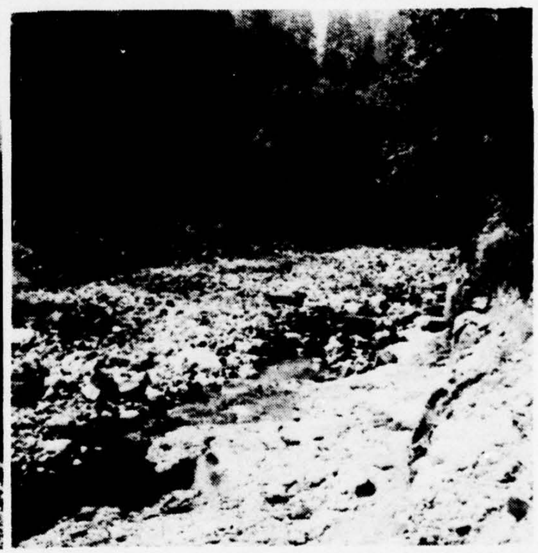


*Photo II-48. Bull Run River.*

*(Oregon State Game Commission photos)*

Some anadromous fish ascend Bull Run River above Bull Run Powerhouse. However, the stream bed in the 6.2-mile section of the river below the headworks dam is composed primarily of bedrock and large rubble, and spawning gravel is scarce compared to supplies located in the upper Bull Run watershed. In recent years, less than a dozen adult spring chinook and summer steelhead have been observed during the summer in the pool beneath the headworks dam. These are the only summer steelhead believed to remain in the subbasin. Neither chinook nor steelhead could be found in 1965.

Numerous salmon and steelhead are attracted into Bull Run River by large volumes of Sandy River water released at the Bull Run Powerhouse. The fish must then either spawn in unfavorable habitat or return to Sandy River. This attraction is greatest in the summer and fall when flows below Marmot Dam are low.

About 1965, a 6-foot high, unladdered rock dam was constructed across Bull Run River immediately below the headworks dam. In 1966 an electric barrier was placed a short distance farther downstream to prevent lampreys from ascending into the water supply network. If operated during anadromous fish migration periods, this barrier, along with the dam and minimal flow releases, will surely eliminate the river's summer steelhead and spring chinook runs.

Waters of nearly the entire Bull Run drainage, 102 square miles, containing eight Cascade lakes, three reservoirs, and approximately 90 miles of favorable salmonid habitat, are reserved by law for exclusive use as the City of Portland's water supply. Public entry to the watershed is prohibited, thereby eliminating fishing and other recreational uses.

Channel straightening and bank revetment of approximately 23 miles of upper Sandy River and tributaries were conducted in 1965 following the 1964-65 floods. As in most such instances, salmonid habitat was adversely affected by altering the natural environment.

Excluding a power right for 800 cfs and municipal use of Bull Run system waters, appropriation in the subbasin is slight (Table II-58).

Table II-58

*Appropriated surface water and minimum streamflow measurement data, Sandy Subbasin (cfs)*

| Stream Area | Appropriated Surface Water 1/ Non-Consumptive | Appropriated Surface Water 1/ Consumptive | Instantaneous Minimum Flows Measured: Instantaneous Discharge 1/ | Location | Date 2/ | Source 2/ |
|---|---|---|---|---|---|---|
| Sandy River downstream from Marmot Dam | 0.0 3/ | 0.0 | 45 | 0.9 mile downstream from Bull Run River | Sept. 26, 1962 (1910-14)(1929-65) | USGS |
| Bull Run R. System | 4 | 1.1 4/ | 9 | Downstream from Bull Run Power Plant. Mile 1.4 | 1951 and 1952 (1949-1954) | USGS |
| Beaver Creek System | 0.0 | 3.7 | 1 | Mile 0.3 | Sept. 6, 1963 | OSGC |
| Cedar Creek System | 33 | 3.4 | 6 | Mile 1.3 | Sept. 12, 1962 | OSGC |
| Gordon Creek System | 0.0 | 19 | 20 | Mouth | Sept. 6, 1963 | OSGC |
| Other tributaries to Sandy River downstream from Marmot Dam | 4 | 19 | - | - | - | - |
| Sandy River upstream from Marmot Dam | 0.0 | 0.0 | 195 | 0.8 mile upstream from Marmot Dam | Nov. 27, 28, 1952 (1911-1967) | USGS |
| Salmon River | 8.6 | 2.5 | 59 | River mile 2.25 | 1936 & 1940 (1936-1967) | USGS |
| Other tributaries to Sandy River upstream from Marmot Dam | 14 | 13 | - | - | - | - |
| Small Columbia River tributary systems | 98 | 5.2 | - | - | - | - |

1/ *Oregon State Water Resources Board records, April 1966.*
2/ *U. S. Geological Survey periods of available records are shown in parenthesis. Oregon State Game Commission listings are the lowest of flows measured monthly in low discharge periods of 1962 and 1963.*
3/ *Not shown is a Federal power right to Portland General Electric Company for 800 cubic feet per second of Sandy and Little Sandy Rivers water.*
4/ *Not included is the substantial municipal water withdrawal by the City of Portland.*

## Developments Beneficial to Fish Resources

The Fish Commission of Oregon operates two fish hatcheries in the subbasin, Bonneville Hatchery at the mouth of Tanner Creek on Columbia River, and Sandy River Salmon Hatchery on Cedar Creek near the town of Sandy (Table II-59).

Table II-59
*Trap counts at Fish Commission of Oregon's Sandy Subbasin Hatcheries 1/*

| Species | Sandy River Hatchery | Bonneville Hatchery |
|---|---|---|
| Winter steelhead | 53 | - |
| Fall chinook | 223 | 2,987 |
| Coho | 6,254 | 7,418 |

1/ *1955-65 average*

Fish liberations made into the waters of the subbasin for the 1961-1965 period are listed in Table II-60.

The subbasin contains 16 private stocked fish ponds and four small private hatcheries. Some of these are open to the public on a fee-fishing basis.

Flows from Sandy River and its tributaries, with a few exceptions, have been withdrawn by legislative act from further appropriation except for stock, domestic, municipal, and public park and recreational purposes. Flows in most of the subbasin's small Columbia River tributaries have been withdrawn from all uses other than fish culture. Table II-61 presents the minimum streamflows recommended by the Game Commission for streams of this subbasin, however no minimum streamflow stipulations have been issued for this basin by Oregon State Water Resources Board.

## Present Economy

Salmonids produced in streams of the subbasin provide an average annual catch of 60,000 coho, 43,500 fall chinook, 2,100 spring chinook salmon, and 400 winter steelhead trout in the Columbia River and Pacific Ocean commercial fisheries. This is estimated to be 932,000 pounds of fish valued at $463,000.

Almost all salmon and steelhead sport fishing in Sandy River is from the bank. The fishery extends from the mouth upstream to Brightwood at river mile 38, but angling pressure is concentrated mainly in the lower 25 miles. Tanner Creek, a Columbia River tributary, and lower Bull Run River are the only other streams open to winter angling for anadromous fish.

Table II-60

*Numbers of fish stocked in Sandy Subbasin, 1961-1965*

| Stream System | Species | Mean Length (Inches) | Number per pound | 1961 | 1962 | 1963 | 1964 | 1965 | Agency |
|---|---|---|---|---|---|---|---|---|---|
| Sandy River | Fall Chinook | - | 1000-1150 | | | 106,500 | | 1,000,000 | FCO |
| " " | Coho | - | 17-64 | 97,800 | | | | | " |
| " " | " | - | 1048-1325 | | 100,300 | 973,300 | 889,700 | 940,000 | " |
| " " | Steelhead | Yearling | - | 163,000 | 168,900 | 216,200 | 200,300 | | OSGC |
| " " | " | 4-6 | - | | | | | 50,700 | " |
| " " | " | - | 11 | 72,300 | | | | | USFWS |
| " " | | 8 & over | - | | | | | 148,900 | OSGC |
| " " | Rainbow | 8 & over | - | 29,100 | 34,100 | 52,200 | 25,300 | 20,200 | " |
| Cedar Creek | Fall Chinook | - | 12.3 | | | | 65,400 | | FCO |
| " " | " " | - | 80-483 | 557,200 | 232,000 | 79,500 | 969,200 | 1,085,700 | " |
| " " | Coho | - | 15-24 | 641,100 | 580,800 | 955,500 | | 801,900 | " |
| " " | " | - | 300 | 50,000 | | | | | " |
| " " | " | - | 1,137 | | | | 23,900 | | " |
| Tanner Creek | Fall Chinook | - | 150-342 | 3,431,800 | 4,201,600 | 4,471,800 | 10,797,500 | 9,601,100 | " |
| " " | Coho | - | 19-29 | 1,319,300 | 893,200 | 1,024,300 | 1,878,000 | 2,614,400 | " |
| " " | " | - | 1000-1200 | | | 200 | | 10,000 | " |
| Horsetail Cr. | Rainbow | 2-4 | - | | | | | 500 | OSGC |
| Collins Lake | Brook trout | 2-4 | - | 600 | 1,100 | | | 1,200 | " |
| " " | Rainbow | 8 & over | - | 1,800 | 2,000 | 2,900 | 1,500 | 2,300 | " |
| Trillium Lake | Brook trout | 2-4 | - | 5,000 | 7,300 | | 3,100 | 5,000 | " |
| " " | Rainbow | 2-4 | - | | 4,100 | 10,000 | | 10,200 | " |
| " " | " | 8 & over | - | 13,900 | 3,000 | 9,800 | 9,700 | 9,200 | " |
| Other Cascade Lakes | Brook trout | 2-4 | - | 7,500 | 7,400 | 11,300 | 4,100 | 7,300 | " |
| " " | Golden trout | 0-2 | - | | 9,700 | | | | " |
| " " | Rainbow | 2-4 | - | 1,400 | | | 1,100 | 1,100 | " |
| " " | " | 8 & over | - | 1,800 | 2,000 | 2,900 | 1,500 | | " |
| Benson Lake | " | 8 & over | - | 7,500 | 4,000 | 6,000 | 8,000 | 7,200 | " |
| Roslyn Lake | " | 2-4 | - | | | 15,000 | | 10,000 | " |
| " " | " | 4-6 | - | | 8,000 | 23,100 | | | " |
| " " | " | 8 & over | - | 6,500 | 9,400 | 8,000 | 6,000 | 8,000 | " |

**Table II-61**

*Minimum flows for fish life recommended to Oregon State Water Resources Board by Oregon State Game Commission (cfs) 1/*

| Stream | Location | Dec.-May | June | July | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|
| Sandy River 2/ | Mouth | 510 | - | - | - | - 510 | 510 | 510 |
| " " | Release from Marmot Dam | - | - | 50 | 50 | 50 - | - | - |
| " " | USGS gage 1370 (Marmot) | - | - | - | 300 | 300 - | - | - |
| " " | Confl. of Zigzag R. | 250 | 200 | 150 100 | 100 | 100 250 | 250 | 250 |
| Alder Creek | Mouth | 25 | 15 10 | 8 5 | 4 | 4 | 4 25 | 25 |
| Beaver Creek | " | 14 | 3 2 | 1 | 1 | 1 | 1 14 | 14 |
| Bull Run R. | USGS gage 1400 | - | - | - | 12 | 12 - | - | - |
| Little Sandy R. | USGS gage 1415 | - | - | 25 20 | 15 | 15 | - | - |
| N. Fk. Bull Run R. | Mouth | - | - | - | 10 | 10 | - | - |
| S. Fk. Bull Run R. | " | - | - | - | 12 | 12 | - | - |
| Cedar Creek | " | 60 | 40 20 | 10 | 10 | 10 20 | 40 60 | 60 |
| Clear Creek | " | 45 | 30 20 | 15 8 | 8 6 | 6 | 6 45 | 45 |
| Clear Fk. Sandy R. | " | 25 | 20 15 | 12 | 8 | 8 | 8 25 | 25 |
| Gordon Creek | " | 50 | 30 20 | 15 | 15 | 15 | 20 50 | 50 |
| Lost Creek | Confl. of Cast Cr. | 20 | 15 | 15 12 | 12 | 12 | 12 20 | 20 |
| Salmon River | Mouth | 250 | 250 | 150 125 | 100 80 | 80 250 | 250 | 250 |
| " " | Confl. of South Fk. | 150 | 150 | 120 90 | 60 | 60 100 | 150 | 150 |
| Boulder Creek | Mouth | 30 | 20 10 | 8 | 5 4 | 3 | 3 30 | 30 |
| Cheeney Creek | " | 35 | 20 10 | 8 | 5 4 | 3 | 3 35 | 35 |
| S. Fk. Salmon R. | " | 35 | 20 10 | 8 | 5 | 5 8 | 15 35 | 35 |
| Trout Creek | " | 35 | 20 5 | 4 3 | 3 | 5 | 5 20 | 35 |
| Zigzag River | " | 200 | 150 | 100 | 75 | 75 200 | 200 | 200 |
| Camp Creek | " | 25 | 20 | 20 | 15 | 15 | 15 25 | 25 |
| Henry Creek | " | 18 | 10 7 | 4 3 | 2 | 2 | 2 18 | 18 |
| Still Creek | " | 60 | 50 40 | 30 25 | 25 | 25 60 | 60 | 60 |
| Small streams tributary to Columbia River | | | | | | | | |
| Bridal Veil Cr. | Mouth | - | - | - | 5 | 4 | - | - |
| Horsetail Cr. | " | - | - | - | 3 | 3 | - | - |
| Latourell Cr. | " | - | - | - | 3 | 3 | - | - |
| McCord Cr. | " | - | - | - | 1 | 1 | - | - |
| Moffet Cr. | " | - | - | - | 1 | 1 | - | - |
| Multnomah Cr. | " | - | - | - | 4 | 4 | - | - |
| Onsonta Cr. | " | - | - | - | 3 | 3 | - | - |
| Tanner Cr. | To arrive at hatchery dam | - | - | - | 15 | 15 | - | - |
| Wahkeena Cr. | Mouth | - | - | - | 2 | 2 | - | - |

1/ *Where 2 figures are shown, minimums change during the month.*
2/ *The spawning flow listed is based on Oregon State Game Commission studies utilizing transects.*

Steelhead receive more angling pressure than do salmon. Total Sandy River (including Bull Run River) steelhead angler effort and catch data collected from 1954 to 1966 are given in Table II-62. A few Sandy River steelhead are caught in Columbia River by sport fishermen. The catch from Tanner Creek averages about 50 steelhead annually.

Averages of 900 coho and 50 chinook salmon are taken annually by anglers in the subbasin. An estimated 12,000 coho, 10,900 fall chinook and 1,100 spring chinook of Sandy Subbasin origin are harvested yearly in the Pacific Ocean, lower Columbia River, and Sandy Subbasin sport fisheries. The contribution of steelhead trout, coho, fall chinook, and spring chinook salmon produced in Sandy Subbasin to the sport fishery is estimated to be 93,000 angler-days valued at $558,000 annually.

An intensive sport fishery for shad takes place in the Sandy River each spring. Angling is conducted primarily from boats near the river mouth as shad enter to spawn in the lower reaches. Fishing effort for shad is also concentrated at the mouth of Tanner Creek. Shad produced in Sandy River contribute to the commercial harvest but neither the commercial nor sport fishery for this species has been evaluated.

In the years that smelt enter the Sandy, sport fishing for this species is intensive in the lower 3 miles of the river. Dip nets are used primarily to catch this highly prized fish. Sport catch records are not available, but Table II-57 lists numbers of smelt licenses sold since 1929. Years showing high license sales indicate the largest runs and heaviest catches. The present daily bag limit is 25 pounds per person.

Stream angling is popular for both wild cutthroat and hatchery rainbow trout. Most of the trout fishing, and therefore most of the trout stocking, is concentrated in the Sandy drainage upstream from Brightwood. Several of the small Columbia River tributaries also furnish angling for wild cutthroat and rainbow trout. Angling intensity in the Cascade lakes depends to a large degree upon accessibility. Benson and Roslyn Lakes receive considerable angling pressure for planted rainbow. An estimated 5,800 angler-days valued at $17,400 and 61,500 angler-days valued at $123,000 are expended on stream and lake trout fishing, respectively, each season in the waters of the subbasin. Angling intensity for warm-water game fish is light and is limited to areas along Columbia River.

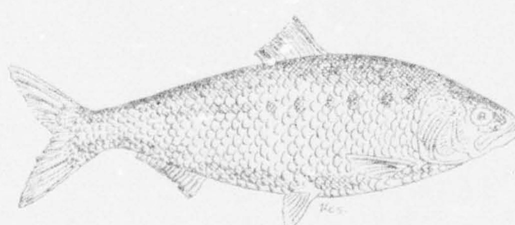


Table II-62

*Sandy River steelhead sport fishery, 1954-1966*

| Angling Season | Total Anglers | Hatchery Fish | | Wild Fish | | Total Steelhead | Fish per Angler |
|---|---|---|---|---|---|---|---|
| | | Number | Percent | Number | Percent | | |
| 1954-55 | 16,000 | 1/ | | 958 | | 958 | 0.06 |
| 1955-56 | 10,413 | 1/ | | 1,157 | | 1,157 | 0.11 |
| 1956-57 | 17,027 | 231 | 24 | 741 | 76 | 972 | 0.06 |
| 1957-58 | 24,485 | 312 | 16 | 1,581 | 84 | 1,893 | 0.08 |
| 1958-59 | 27,934 | 93 | 7 | 1,213 | 93 | 1,306 | 0.05 |
| 1959-60 | 30,079 | 247 | 12 | 1,824 | 88 | 2,071 | 0.07 |
| 1960-61 | 32,391 | 182 | 12 | 1,312 | 88 | 1,494 | 0.05 |
| 1961-62 | 20,354 | 15 | 1 | 1,056 | 99 | 1,071 | 0.05 |
| 1962-63 | 25,074 | 195 | 15 | 1,107 | 85 | 1,302 | 0.05 |
| 1963-64 | 23,421 | 1,756 | 46 | 2,062 | 54 | 3,818 | 0.16 |
| 1964-65 | 19,516 | 2,204 | 45 | 2,694 | 55 | 4,898 | 0.25 |
| 1965-66 | 18,074 | 2,582 | 55 | 2,155 | 45 | 4,737 | 0.26 |

1/ *Fish were planted but returns were not expected until 1956.*

# WILDLIFE

## GENERAL

Willamette Basin is enriched by a varied and abundant wildlife resource. Thousands of deer, pheasants, quail, doves, pigeons, furbearers and waterfowl are harvested annually in the basin and millions of hours of outdoor relaxation and enjoyment are provided for residents and visitors alike.

Deer, pheasants, and waterfowl provide the largest share of the basin's wildlife recreation. Commercially, the beaver makes up the bulk of the fur harvest income of Willamette Basin. The most universally unwelcome fur animals in the basin are nutria and opossum.

Marginal agricultural lands, farmlands, mixed woodlands, wetlands, young forest burns and clear-cuts, streambank woodlands and brush patches provide the most valuable and productive wildlife habitat of the basin.

Changes in land use have vitally affected wildlife in Willamette Basin, and will continue to do so in the future. Some developments have adverse effects on wildlife. Storage reservoirs flood wildlife habitat and change downstream flow patterns. Stream channelization and pollution are destroying habitat. Wetland drainage, urbanization and industrial expansion are removing thousands of acres of upland game, furbearer, and waterfowl habitat. Also, the intensive agricultural practices now popular are seriously reducing the wildlife productivity of the land. On the other hand, water developments may improve or increase wildlife habitat. Upland game populations frequently increase when dry-farmed land is irrigated. Drainage ditches may furnish excellent habitat for waterfowl and upland game. Some reservoirs supply resting and feeding areas for waterfowl.

## INVENTORY AND DISTRIBUTION

Wildlife are found in varying numbers and diverse localities throughout Willamette Basin and are important from the standpoint of hunter-use or population. Several major wildlife groups are represented--big game, upland game, furbearers, and waterfowl.

In the following discussion, the basin's wildlife forms are presented by major wildlife groups (Table II-63). Species sparsely represented or no longer found in the basin are discussed under Miscellaneous Species. Species in each group are discussed according to their importance in Willamette Basin; individual species of like or closely related genera are separated in some instances.

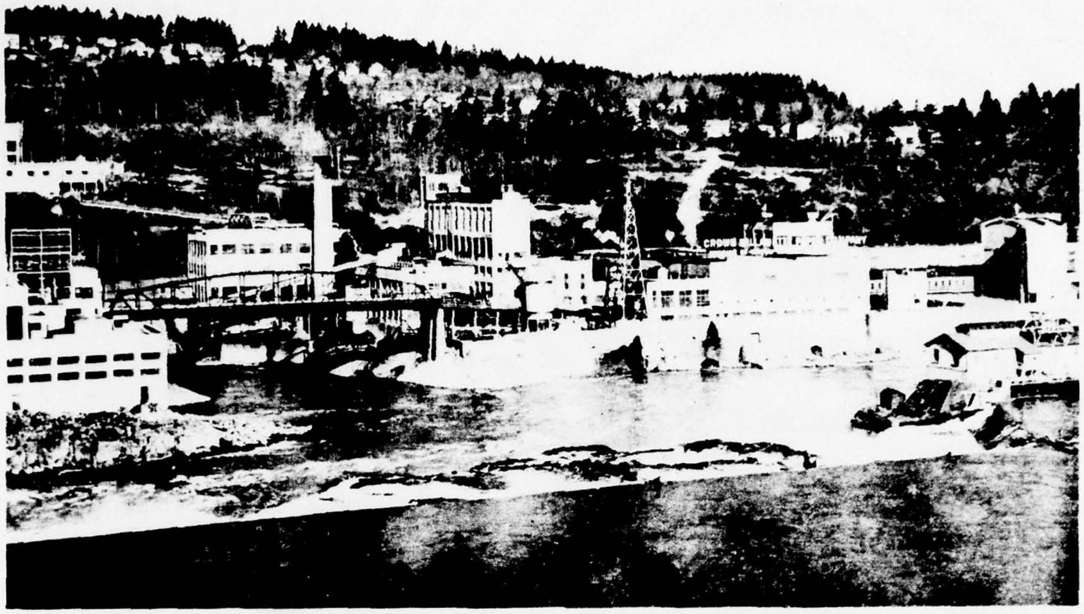


*Photo II-49. At Willamette Falls industry long ago occupied the streamside habitat; now urban growth is whittling away at the dryland habitat. (Oregon State Game Commission photo)*

*Photo II-50. Urban expansion and industrialization are rapidly reducing the area available for wildlife. (Oregon State Highway Department photo)*

Table II-63
*Willamette Basin Wildlife*

| Scientific Name | Common Name |
|---|---|
| **BIG GAME:** | |
| *Odocoileus hemionus columbianus* | Black-tailed deer |
| *O. hemionus hemionus* | Mule deer |
| *O. virginianus* | White-tailed deer |
| *Cervus canadensis roosevelti* | Roosevelt elk |
| *Ursus americanus* | Black bear |
| *U. Klamathensis* | Grizzly bear 1/ |
| *Felis concolor* | Cougar |
| **UPLAND GAME:** | |
| *Phasianus colchicus* | Ring-necked pheasant 2/ |
| *Perdix perdix* | Hungarian partridge 2/ |
| *Logphortyx californicus* | Valley (California) quail 2/ |
| *Oreortyx pictus* | Mountain quail |
| *Colinus virginianus* | Bobwhite quail 2/ |
| *Columba fasciata* | Band-tailed pigeon |
| *Zenaidura macroura* | Mourning dove |
| *Dendragapus obscurus* | Blue grouse |
| *Bonasa umbellus* | Ruffed grouse |
| *Sciurus griseus* | Gray squirrel |
| *Lepus americanus* | Snowshoe rabbit |
| *Sylvilagus floridanus* | Eastern cottontail 2/ |
| *Didelphis virginiana* | Opossum 2/ |
| **FURBEARERS:** | |
| Procyon lotor | Raccoon |
| Ondatra zibethica | Muskrat |
| Myocastor coypus | Nutria 2/ |
| Castor canadensis | Beaver |
| Mustela vison | Mink |
| M. frenata | Long-tailed weasel |
| Martes americana | Marten |
| M. pennanti | Fisher |
| Lutra canadensis | Otter |
| Mephitis mephitis | Striped skunk |
| Spilogale gracilis | Spotted skunk |

| Scientific Name | Common Name |
|---|---|
| **WATERFOWL:** | |
| *Branta canadensis* | Canada goose |
| *Subfamily Anatinae* | Pond ducks |
| *Anas platyrynchos* | Mallard |
| *A. acuta* | Pintail |
| *A. carolinensis* | Green-winged teal |
| *A. discors* | Blue-winged teal |
| *A. strepera* | Gadwall |
| *Mareca americana* | American widgeon (baldpate) |
| *Spatula clypeata* | Shoveler |
| *Aix sponsa* | Wood duck |
| *Subfamily Aythyinae* | Diving Ducks |
| *Histrionicus histrionicus* | Harlequin |
| *Bucephala albeola* | Bufflehead |
| *B. islandica* | Barrow's goldeneye |
| *B. clangula* | Common goldeneye |
| *Oidemia nigra* | Common scoter |
| *Melanitta perspicillata* | Surf scoter |
| *M. deglandi* | White-winged scoter |
| *Aythya americana* | Redhead |
| *A. collaris* | Ring-necked duck |
| *A. valisinoria* | Canvasback |
| *A. marila* | Greater scaup |
| *A. affinis* | Wesser scaup |
| *Subfamily Oxyurinae* | Diving ducks |
| *Oxyura jamaicensus* | Ruddy duck |
| *Subfamily Merginae* | Diving ducks |
| *Mergus merganser* | Common merganser |
| *M. serrator* | Red-breasted merganser |
| *Lophodytes cucullatus* | Hooded merganser |
| *Olor columbianus* | Whistling swan |
| **PREDATORS:** | |
| *Vulpes fulva* | Red fox |
| *Urocyon cinereoargenteus* | Gray fox |
| *Gulo luscus* | Wolverine |
| *Canis latrans* | Coyote |
| *C. lupus* | Gray timber wolf 1/ |
| *Lynx rufus* | Bobcat |
| *Haliaeetus leucocephalus* | Bald eagle |
| *Aquila chrysaetos* | Golden eagle |

1/ *Extinct in Willamette Basin* 2/ *Introduced*

## Big Game

Important big-game species in Willamette Basin include black-tailed deer, Roosevelt elk, and black bear. Distribution is shown on Figure II-7.

### Black-tailed Deer

Black-tailed deer range over nearly the entire basin. Only in areas of dense urban development or in mature, closed-canopy coniferous forests are deer scarce or absent. Historically, the distribution of black-tailed deer was probably very similar to what it is today.

Black-tailed deer are usually found in brushy, "edge-type" habitat characterized by stands or patches of broad-leafed brush species interspersed with fields, pastures, meadows, or coniferous forests. This habitat is most common in marginal farming areas and in 3- to 15-year-old forest clear-cuts and burns.

*Photo II-51. Black-tailed deer.*

The present population is estimated at 135,000, with a peak population during the past 10 years of about 150,000 animals. Black-tailed deer constitute almost the entire deer population in the basin. There are indications that many more deer are present now than at any time before 1930. Since that time deer populations have boomed as a result of stricter harvest controls and increased habitat area. Populations reached a peak during the years 1955 through 1960, but declined slightly in the subsequent 5 years.

## Roosevelt Elk

Roosevelt elk, sometimes called coastal or Olympic elk, are found in several parts of the Coast and Cascade Ranges within the basin, especially in the drainages of the McKenzie and Middle Fork Willamette Rivers. Elk are predominantly a forest species but, like the deer, rarely use the mature, closed-canopy coniferous forests. They are most plentiful in areas where clear-cuts, burns, and other disturbances have opened up the forest for growth of broad-leafed browse species. Historically, elk were more widely distributed at lower elevations, but agricultural and urban developments apparently have driven them from the valley floor. Logging of mature coniferous stands is increasing the available elk habitat and their range is expanding at the higher elevations.

There are 2,000 or more elk in Willamette Basin, probably more than ever before, and the population is increasing yearly.

## Black Bear

Black bear may be found almost anywhere in Willamette Basin except in dense urban areas. They are most plentiful in the forested and less developed areas.

The black bear population is estimated at 14,000 animals. Populations probably reached their highest level before 1940. Since then numbers have tapered off and recently stabilized under the pressure of increased hunting.

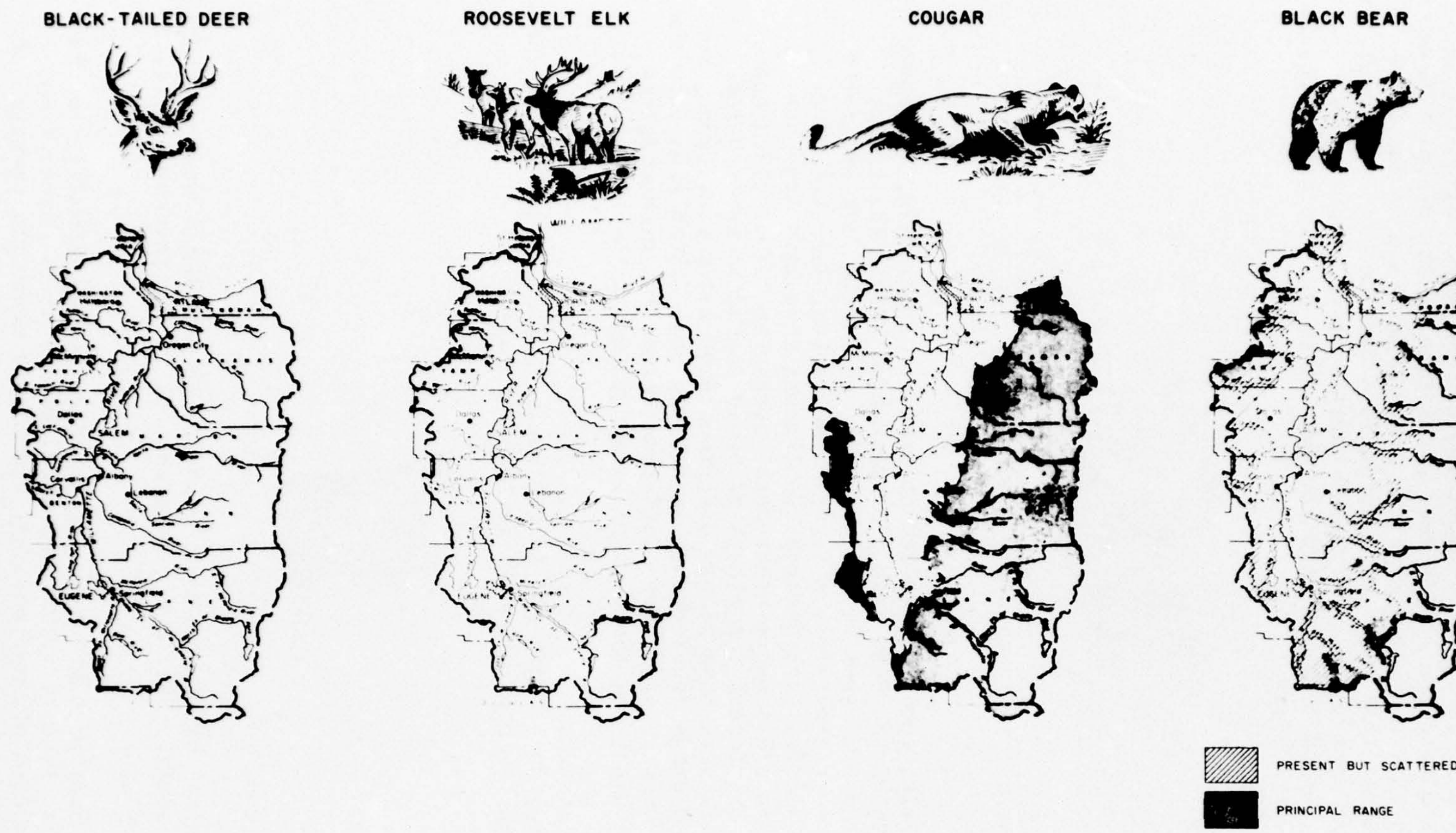



*Figure II-7  Big game distribution*

*Photo II-52. Elk grazing among forest debris. (U. S. Forest Service photo)*

<u>Cougar</u>

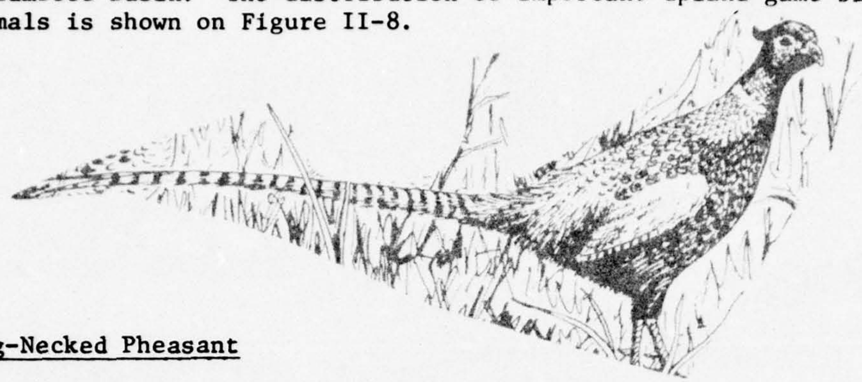
Cougar require a primitive or wilderness habitat relatively undisturbed by man and are now restricted to the most uninhabited areas in the basin. The individual cougar (mountain lion) is a far-ranging animal that may include hundreds of square miles within its home range. Cougar population is very low and there are probably only about 50 in the basin.

<u>Mule Deer</u>

Mule deer are summer residents near the crest of the Cascades in Linn and Lane Counties. Early in the fall these animals migrate eastward into central Oregon.

## Upland Game

Ring-necked pheasant, valley quail, band-tailed pigeons, and mourning doves are the four important species of upland game in Willamette Basin. The latter two species are migratory birds. Upland game includes both mammals and birds, but no small animals are important as game in Willamette Basin. The distribution of important upland-game birds and mammals is shown on Figure II-8.



## Ring-Necked Pheasant

Since introduction, pheasants have spread rapidly to all suitable habitat within Willamette Basin. Pheasant habitat is characterized by fields, pastures, or meadows interspersed with brushy cover such as is found on the valley floor.

The average annual maximum population of pheasant is estimated at about 400,000 birds. The pheasant population reached its peak in the early 1900's but has since declined significantly due to habitat reduction.



## Quail

Valley (California) quail is the most common species of quail in Willamette Basin. They are found on the valley floor and in much the same range as the ring-necked pheasant since habitat requirements are very similar. Bobwhite quail, not common, are also scattered throughout the same habitat. Mountain quail prefer the foothill and forested areas excepting the most dense, mature forests and higher, near-alpine areas.

The average annual maximum population for all three quail is estimated at 220,000 birds. Quail populations reached a peak during the first half of this century but have since tapered off because of reduced habitat.

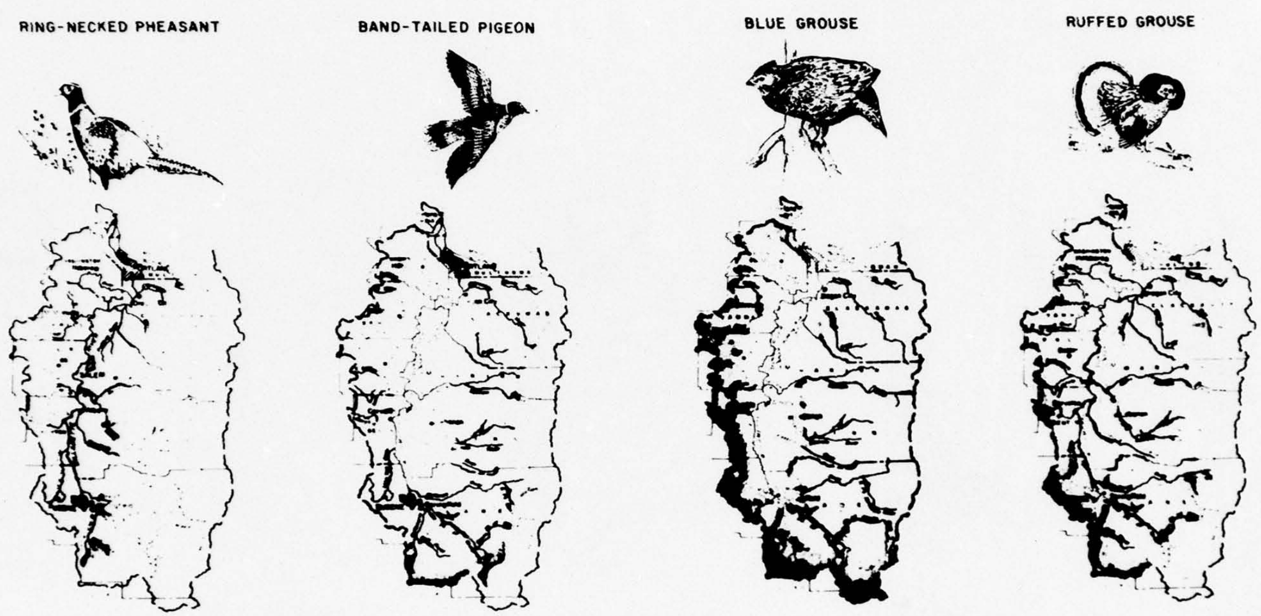



*Figure II-8   Upland game distribution*

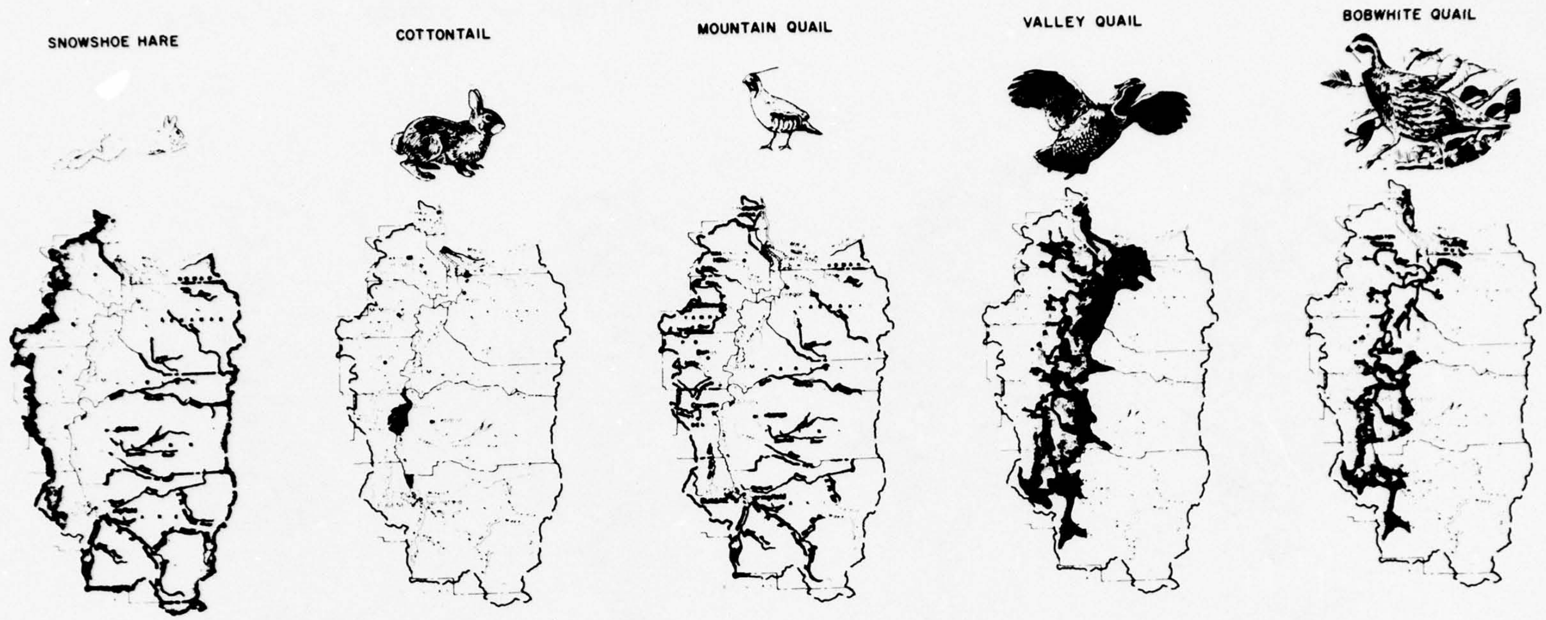



*Figure II-8 (Cont.)* *Upland game distribution*

Band-tailed Pigeon

Band-tailed pigeons, are found in Willamette Basin from spring to early fall. These birds nest in coniferous trees at low to moderate elevations and, except during migration, are not generally found on the valley floor.

The late-summer pigeon population is estimated at 200,000 birds. Band-tailed pigeon populations have probably been relatively unaffected by man's developments in the basin.

Mourning Dove

Mourning doves are present from spring through the fall and a few remain throughout the winter. Doves nest in wooded areas and orchards along the valley floor and low foothills. During fall migration they may be found throughout the lower elevations.

Mourning doves are fairly plentiful and number about 500,000 in the basin during late summer. Since urbanization and intensive agricultural development have reduced the available nesting habitat, there may have been minor reductions in mourning dove numbers recently. However, the population is probably still higher than it was before the turn of the century.

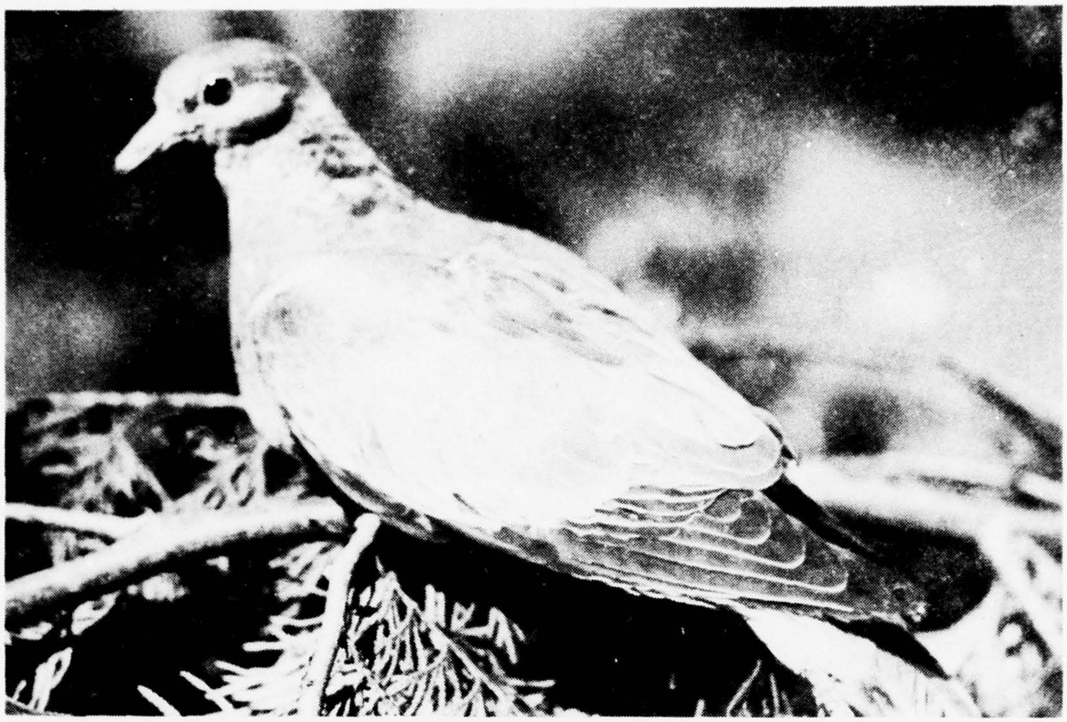


Photo II-53. Mourning doves furnish early-fall hunting in Willamette Basin. (Oregon State Game Commission photo)

Photo II-54. Ring-necked pheasants, Oregon's most popular upland game bird. (Oregon State Game Commission photo)

Grouse

Blue grouse are primarily coniferous forest residents and are found in the foothill and upland areas. The ruffed grouse is less of a forest dweller and may be found in brushy and wooded areas from the Willamette River banks to the Coast Range and foothills of the Cascade Range. They are not found in areas of intensive agricultural or urban development.

The combined blue and ruffed grouse populations are estimated at 65,000. Grouse populations appear to be cyclic; that is, numbers fluctuate naturally over a regular period of several years from extreme lows to extreme highs without apparent influence from outside factors. For example, grouse population was at a low ebb in 1965 whereas it appeared to be at its maximum in 1959. Since these fluctuations are recurring, it is thought that the grouse population has remained about the same as in the past.

Gray Squirrel

Western gray or silver gray squirrels require an arboreal habitat, such as stands of deciduous or coniferous trees. Largest populations are present in the valleys and foothills of the Tualatin, Long Tom, Mohawk, and Calapooia River drainages, in Willamette Valley near Corvallis, Salem, Eugene, and Springfield, and in the Muddy Creek area of Benton County. Agricultural development, industrialization and urbanization have apparently had little effect on total distribution since they may be found in city parks as well as in relatively primitive areas. Gray squirrel population is estimated at 50,000.

*Photo II-55. Ruffed grouse, an elusive Willamette Valley game bird. (Oregon State Game Commission photo)*

*Photo II-56. Snowshoe rabbits are common in woody and brushy habitat. (Oregon State Game Commission photo)*

## Eastern Cottontail

Eastern cottontails have never really taken hold, and are still found in only a few scattered locations. They are adapted to brushy areas along field edges and lowland stream banks. This species is apparently unsuited to the climate and habitat of Willamette Basin since its introduction did not result in a large population.

## Snowshoe Rabbit

Snowshoe rabbits or varying hares are primarily forest dwellers and are found throughout the forest and foothill regions of Willamette Basin. Populations have probably not changed significantly during the past century except for local population increases associated with logging clear-cuts. Population of all rabbits and hares is estimated at 240,000.

## Opossum

Opossum, introduced in the 1930's, occupy much of Willamette Basin north of Corvallis. They are very adaptable as to habitat and may be found from downtown Portland to relatively primitive forested areas. The present population is estimated at 20,000. Opossum are increasing and spreading, and soon will occupy all suitable habitat within the basin.

*Photo II-57. The large native tree squirrels are called western grey, or silver-grey squirrels. (Oregon State Game Commission photo)*

*Photo II-58. Opossum were introduced into Willamette Basin in the 1930's but were in Oregon before that time according to this photo taken at the Baker Sportsmen's Show in 1924. (U. S. Forest Service photo)*

## Waterfowl

Willamette Basin is located along the Pacific Flyway, one of the major migratory-bird routes on the continent of North America. Important waterfowl in the basin include Canada geese and several species of pond ducks. Several species of diving ducks, and whistling swans as well, are found in the basin but not in large numbers.

### Canada Goose

Canada geese are found in Willamette Basin primarily during the fall and early winter. During this period they use the wetlands, lakes, reservoirs, and larger streams on the valley floor for resting area and feed in nearby fields and pastures. Wintering populations have averaged about 14,400 birds in recent years. This is less than it was in the past due to reduction in available habitat. Most of these birds are dusky Canada geese and Vancouver Canada geese; races with very specialized nesting and wintering area requirements. Since Willamette Basin is the primary wintering area for the dusky geese, and an important wintering area for the Vancouvers, three small National Wildlife Refuges have recently been established in the basin to protect them from extinction.

*Photo II-59. Canada geese are the most sought-after waterfowl in Willamette Basin. (Bureau of Sport Fisheries and Wildlife photo)*

Pond Ducks

Pond ducks are present in Willamette Basin all year around. They nest along nearly all streams, lakes, and reservoirs in the basin. Migrating and wintering populations use lowland streams, lakes, reservoirs and wetlands for resting and feeding areas. Important pond ducks present include mallards, pintails, and American widgeons or baldpates. Others are green-winged teal, gadwall, blue-winged teal, shoveler, and wood duck.

Average winter population of pond ducks in Willamette Basin during a recent 5-year period was about 175,000 birds. As is the case throughout much of the continental United States, pond duck populations in the basin have declined more-or-less steadily since the turn of the century. Recently, however, populations in Willamette Basin have been fairly stable.

Diving Ducks

A few diving ducks nest in scattered locations in Willamette Basin. Harlequin ducks, Barrow's goldeneyes, and buffleheads are rare nesters along the higher reaches of the major streams and in the high lakes of the Cascade Range. During the fall and winter, diving ducks can be found on most of the lower-elevation waters of Willamette Valley. These species prefer deep-water streams, lakes, and reservoirs for resting and feeding.

The nesting population of diving ducks is low. The wintering populations averaged 2,700 birds. Due to reduced habitat and increased hunting pressure, populations have declined throughout the area over the past 30 years.

In addition to the species mentioned previously, other diving ducks present include redheads, ring-necked ducks, canvasbacks, greater scaups, lesser scaups, common goldeneyes, surf scoters, white-winged scoters, common scoters, ruddy ducks, hooded mergansers, common mergansers, and red-breasted mergansers.

Whistling Swan

Whistling swans are winter residents of Willamette Valley. They are found primarily on lower Willamette River, Sauvie Island, and Columbia River. The average population over the past several years has been 1,000.

## Furbearers

Several species of fur-bearing animals are found in Willamette Basin. The most common species are raccoon, muskrat, nutria, beaver, and mink. Trapping of most furbearers is strictly regulated. Distribution of some common furbearers is shown in Figure II-9.

### Raccoon

Raccoons are found throughout the basin except in the higher-elevation coniferous forests. They are basically compatible with the presence and activities of man, and are frequently found in the residential areas of cities and towns. Agricultural development and the opening of forests by logging and forest fires have probably increased the amount of habitat available to the raccoon. They are presently very abundant, numbering an estimated 50,000.

### Muskrat

Muskrat are found in marshes and slower-moving streams throughout the lower elevations of the valley. In recent years there has been a reduction in habitat due to wetland drainage, increased industrialization and urbanization, and water pollution.

Muskrats in the basin number about 50,000. Since muskrats were never as valuable as the beaver, they did not suffer from excessive trapping during Oregon's early history. Muskrat populations have been fairly stable until recent years when diseases, habitat reduction, and competition from the larger nutria brought about a decrease.

### Nutria

Nutria requirements are almost identical to those of muskrats, and thus they compete directly for available habitat. Nutria were introduced into Oregon within the last 25 years when they were released by unsuccessful fur farmers and breeders who had been raising them commercially. Nutria are extending their range to all areas of suitable habitat. The present population is estimated at about 20,000 and is rapidly increasing.

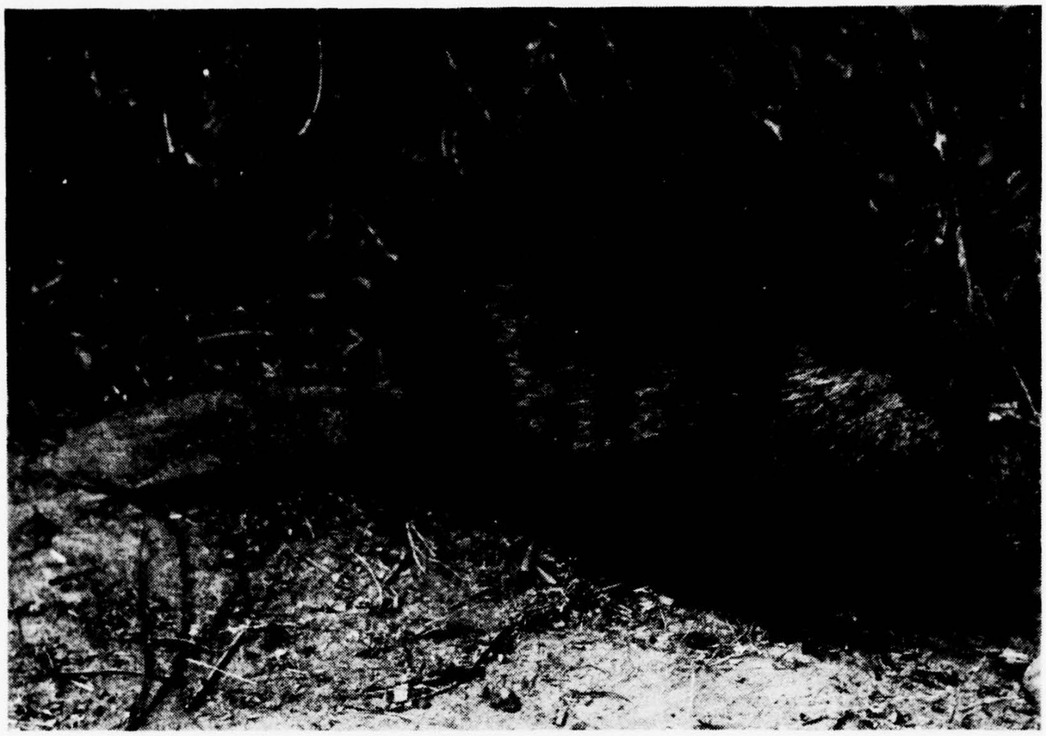


*Photo II-60. In the early 1800's Willamette Valley was considered the finest hunting ground for beaver west of the Rocky Mountains. (Oregon State Game Commission photo)*

## Beaver

Beaver are found throughout the basin in any except the most precipitous streams. They prefer a habitat where there is an abundance of streamside growth such as willows, alder, birch, and aspen. Beaver require clean water and will only tolerate industrial and agricultural development that does not destroy streamside habitat or degrade water quality.

Beaver population in the basin is estimated at 10,000 animals. Willamette Basin supported a large beaver population when the earliest explorers and fur trappers visited the area in the early 1800's but excessive trapping soon depleted this stock and very few were left by the turn of the century. Trapping of beaver was outlawed or severely regulated from about 1895 through 1951, and beaver staged a remarkable comeback during this time. Present populations are now sufficient for an annual harvest of pelts. Recently, habitat degradation and pollution have eliminated the beaver from parts of Willamette River and some of its larger tributaries.

## Mink

Mink can be found throughout the basin wherever there is suitable aquatic habitat. They require clean water and a stream or lake habitat relatively undisturbed by industrialization, urbanization, or intensive agricultural development. Mink are not restricted to larger streams and lakes but range up the smaller tributaries and into the surrounding countryside.

The mink population in the basin is probably about 10,000. The present population is less than it was formerly because of reduced quantity and quality of habitat and overtrapping in past years. The heaviest concentrations are found along the streams and lakes in the less developed forested areas of the basin.


## Marten

Marten are found throughout the coniferous forests of the basin. The present population in Willamette Basin, about 1,000 animals, is considerably lower than formerly because of extensive trapping and reduced habitat.

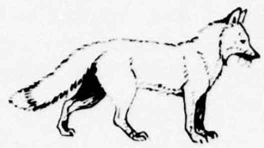
## Otter

River otter may be found in nearly any lake or large stream in Willamette Basin. They are semiaquatic and require an environment relatively undisturbed by pollution, industrialization and agriculture.

There are possibly as few as 500 river otter in the basin. Most of these may be found in the higher-elevation lakes and in the undisturbed portions of the larger streams. Due to reduced habitat and increased trapping pressure, the present population is considerably less than it was before the white men came to Oregon

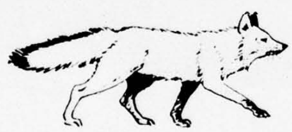
## Predators

Important predatory mammals in Willamette Basin include red fox, gray fox, coyote, and bobcat (Figure II-9). There are many predatory birds including bald and golden eagles, which are relatively rare in the basin. These birds are usually more beneficial than harmful, and are protected by Federal and State law.



### Red Fox

There are two subspecies of red fox in the basin, the pale form native to the upper slopes of the Cascade range and the upper basin, and the more brightly colored, introduced subspecies. The former is unimportant either as a furbearer or predator, but the latter have spread to most of the suitable valley habitat and may create problems in farming areas because of their fondness for poultry. Population is estimated at 7,000. There is evidence of a recent increase in numbers in certain areas.



### Gray Fox

Gray fox inhabit the foothills of the Coast and Cascade Ranges. They were once probably found throughout all the brushy and open country of the foothills and valley floor, but human population pressures, and possibly competition from the introduced red fox, have reduced their former range.

The present population is estimated at 5,000. The population likely remained fairly constant over the past century, but predator control measures and decreasing habitat have probably reduced numbers in recent years.

## Coyote

Coyotes are found throughout Willamette Basin except on Sauvie Island, in the most dense urban areas, and in extensive stands of mature coniferous forest. They may have been present before the advent of white men but only recently have spread throughout most of the basin. Increasing development of the area and the coyote's adaptation to these changes have brought about a pronounced increase in the population during the last 25 years.

The present population of 5,000 animals is fairly stable, being held in check by predator control measures and available food supply.

*Photo II-61. There are an estimated 5,000 bobcats in Willamette Basin. (Bureau of Sport Fisheries and Wildlife photo)*

## Bobcat

Bobcats occupy most of Willamette Basin except urban areas and the valley floor. They are usually found in brushy, broken country intermixed with forested and marginal agricultural lands.

Bobcat population is estimated at 5,000, and has probably remained fairly constant over the years. Although intensive agricultural and urban development forced the bobcat away from the valley floor, logging, forest fires, and other developments have opened new habitat in the Cascade and Coast Ranges.

## Eagles

The population and distribution of bald eagles is drastically reduced from former years. They are now in danger of extinction in this part of the state. Those remaining may be found near lakes and larger streams in the more primitive and rugged areas of the basin.

The golden eagle lives along river bottomlands and in the more rugged foothill and forested areas of the basin. Populations have been greatly reduced over the past 100 years as a result of predator control measures.

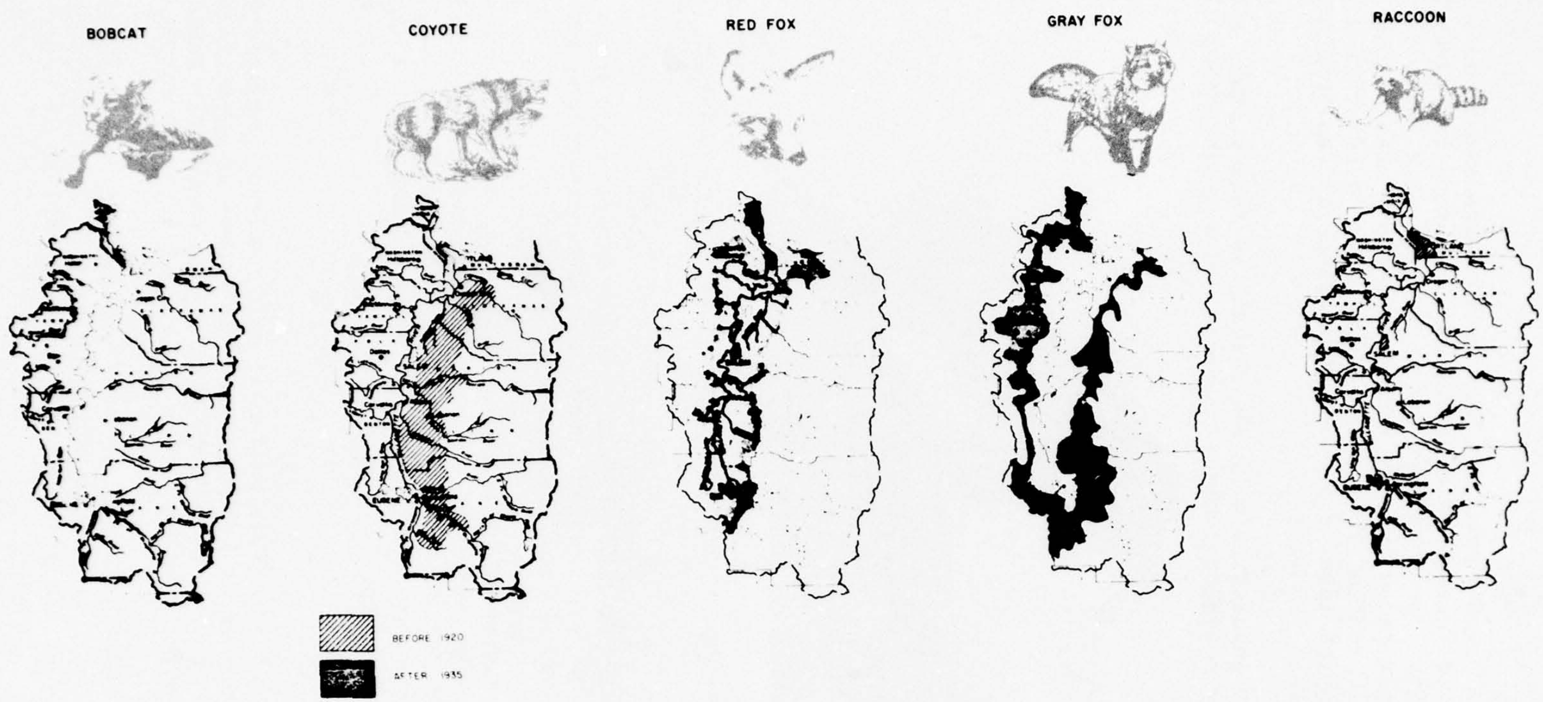



*Figure II-9 Fur animal distribution*

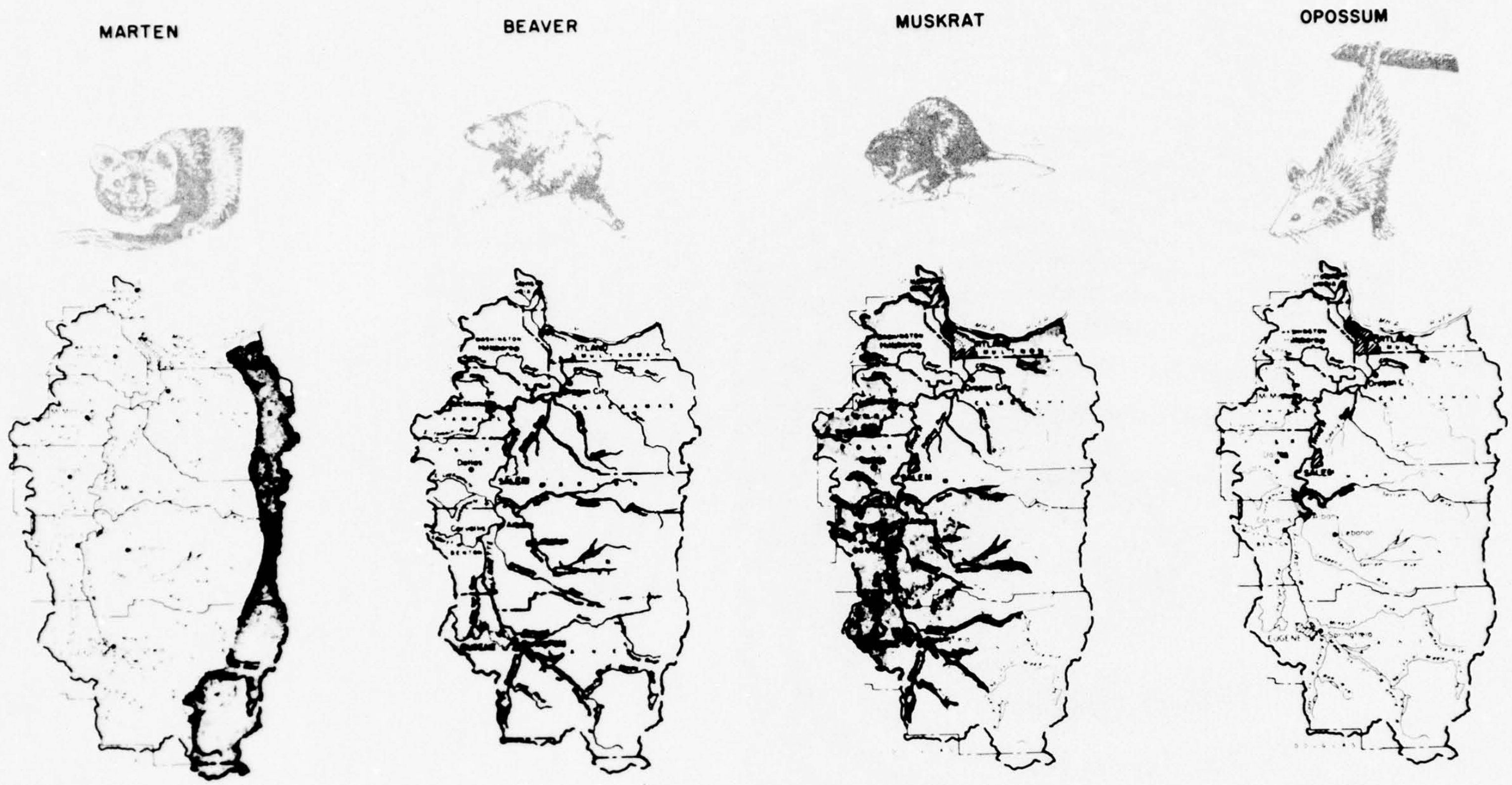



*Figure II-9 (Cont.) Fur animal distribution*

*Photo II-62. A few bald eagles may still be found near lakes and larger streams of the basin. (Bureau of Sport Fisheries and Wildlife photo)*

## Miscellaneous Species

Hungarian partridges were introduced in the 1930's, but never really took hold and are presently very rare or absent. The grizzly bear and the wolverine were once fairly common but the grizzly has long been gone from the state and the wolverine is very rare. White-tailed deer are present along Columbia River in the northwest edge of the basin. Striped and spotted skunks and longtailed weasels are relatively common throughout the basin and are significant as furbearers or predators. The fisher, a fur bearer once present throughout the coniferous forests in the basin, was overharvested and is now limited to the high Cascades in the southwest corner of the basin. Trapping of this species is prohibited. The gray timber wolf was once present throughout Willamette Basin but is now thought to be extinct in Oregon. The last recorded kill in the basin was in 1940.

The wildlife described in the previous pages probably represent the most important species either presently or historically in Willamette Basin. Many other birds and mammals are important adjuncts to the enjoyment of such outdoor recreation activities as hiking, bird watching, outdoor photography and nature study, but detailed discussion of them is outside the scope of this report.

## UTILIZATION

The wildlife of Willamette Basin are hunted for sport, livelihood, or control of populations. Although there are some exceptions, big game, upland game, and waterfowl are generally hunted for sport, furbearers for income, and predators for population control.

Hunting has been regulated for many years, but the success of management programs has permitted liberalizing open seasons in some cases. Each year, seasons are established according to the amount of hunting pressure that the population of each species can withstand. Wildlife populations are managed to provide maximum hunting opportunities and to avoid conflicts with other uses of the land.

Hunter-day use for the purposes of this study is evaluated under the standards set forth in Supplement 1 of Senate Document 97, Evaluation Standards for Primary Outdoor Recreation Benefits. For Willamette Basin $5.00 per hunter-day is usually assigned for big-game hunting, $3.00 per day for upland-game hunting, $1.00 to $2.00 per day for small game and miscellaneous hunting, and $4.00 to $4.50 per day for waterfowl hunting. These values reflect "...the amount that the users should be willing to pay, if such payment were required, to avail themselves of the...recreation resources." Thus, by definition, these are net values above and beyond hunter expenditures. The National Survey of Fishing and Hunting for 1965, by the Bureau of Sport Fisheries and Wildlife, indicated that for the United States as a whole, expenditures per hunter-day were $9.55 for big-game hunting, $4.79 per day for small-game hunting, and $6.44 per day for waterfowl hunting. According to the survey, for each 100 persons who hunted in 1965, there were approximately 60 people who were bird watchers and 23 who were wildlife photographers. These activities are usually evaluated at $1.00 per day.

### Big Game

Big game are hunted primarily in the foothills and mountains of the basin. More than 30,000 animals are taken each year, of which more than 29,000 are deer. Almost 325,000 hunter-days of recreation are spent annually in pursuit of big game.

#### Deer

Deer hunting in Willamette Basin occurs primarily in the Coast Range and the foothills of the Cascade Range. Hunters prefer areas where logging, forest fires, and agriculture have created openings in the forest, such as in tree farms of Coast Range, Coast Fork, Middle Fork, McKenzie, and Santiam Subbasins, and in logging clear-cuts in Clackamas and Pudding Subbasins.

*Photo II-63. A young hunter with his first buck. (Oregon State Game Commission photo)*

Deer hunting in Oregon was relatively unrestricted until populations reached their lowest ebb about 1920, at which time hunting was severely curtailed and a bucks-only regulation imposed. A general either-sex season was not again authorized until 1953. Starting in 1958 hunting of antler-less deer was apportioned on a unit-permit basis. Figure II-10 shows the estimated number of hunters and deer harvest for the period 1948-65.

The present general deer season is usually 3 weeks long and is held during October. Early, extended, and controlled seasons are also held to more fully exploit the recreational potential of the resource and to control deer populations in certain problem areas. For instance, an early high-Cascade buck season has been held in recent years providing high-quality recreation. Also, usually deer of either sex may be killed during the last 9 days of the general season by hunters holding permits apportioned on a unit basis. In 1965, 29,000 permits were issued for Willamette Basin management units. A special archery season was open for 2 months in part of the basin. In all, hunting was open in all or part of the basin for 78 days in 1965.

It is estimated that an annual average of 65,700 hunters harvested 29,400 deer, providing an average 310,300 hunter-days of recreation. Willamette Basin provides 20 percent of Oregon's annual deer harvest for 24 percent of the hunters, and furnishes 23 percent of the hunter-days of recreation.

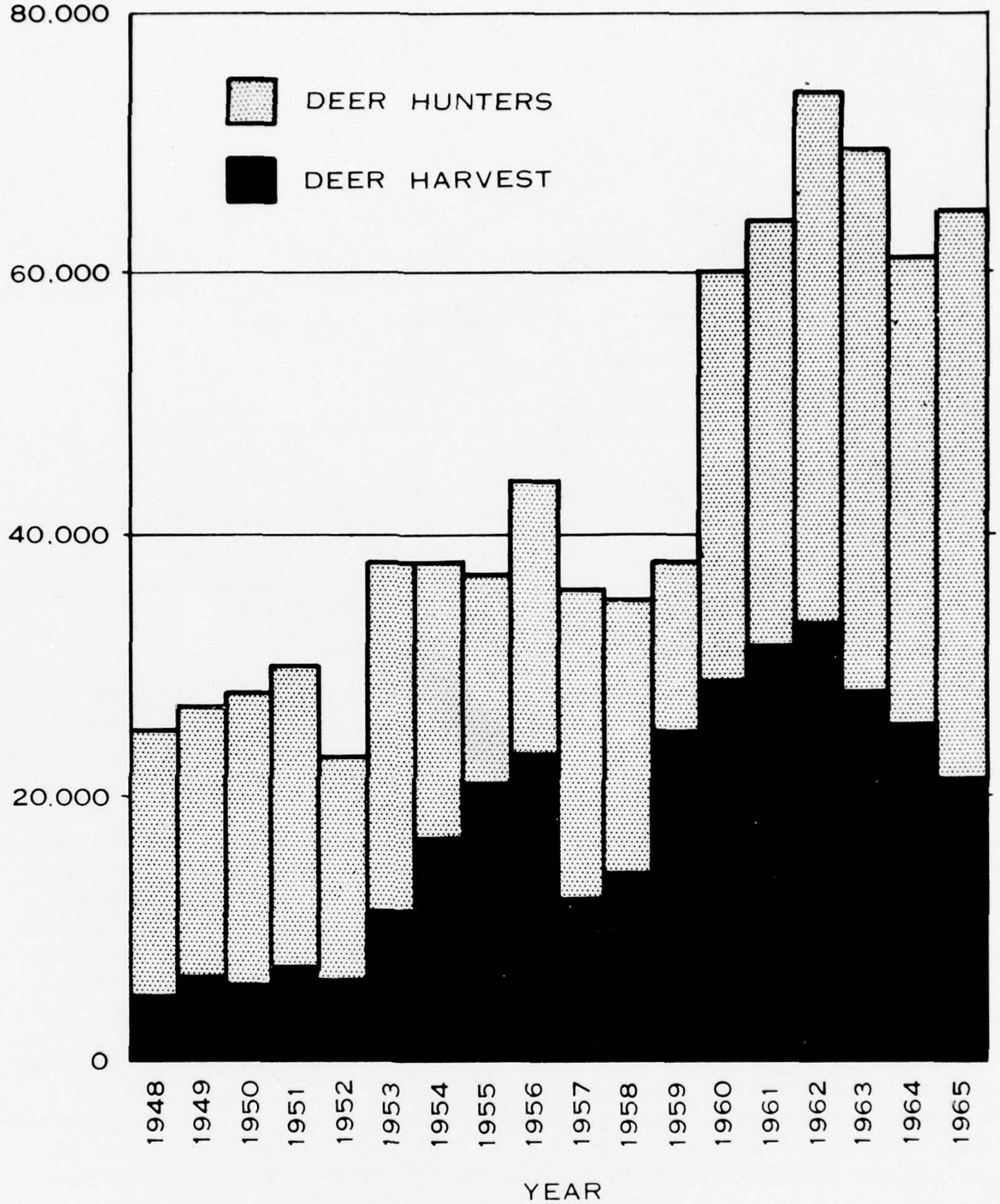



*Figure II-10* *Estimated deer hunters and harvest, 1948-1965*

*Photo II-64. Wintering Roosevelt elk. This is typical low-elevation big game winter range in Willamette Valley. (Oregon State Game Commission photo)*

## Elk

Almost all elk hunting in Willamette Basin occurs at higher elevations in the Yamhill and Tualatin drainages of the Coast Range, and in the Clackamas, North Santiam, McKenzie, and North Fork and Middle Fork Willamette drainages of the Cascade Range. Elk hunting is a much more rugged sport than deer hunting and weather during the season is more severe. Access to popular hunting areas is frequently restricted by adverse road and weather conditions.

Elk hunting was severely curtailed throughout Oregon for the first half of this century. Not until 1948 were there sufficient elk in Willamette Basin to allow regular open seasons. Elk season is generally held in early November and is 16 days long. The estimated number of hunters and elk harvested during the period 1948-65 is shown in Figure II-11.

Based on random hunter surveys, it is estimated that an average of 1,400 hunters harvested 200 elk annually in the basin during recent years, providing about 8,000 hunter-days of recreation. The basin provides 1.5 percent of Oregon's annual elk harvest for 2.4 percent of the hunters.

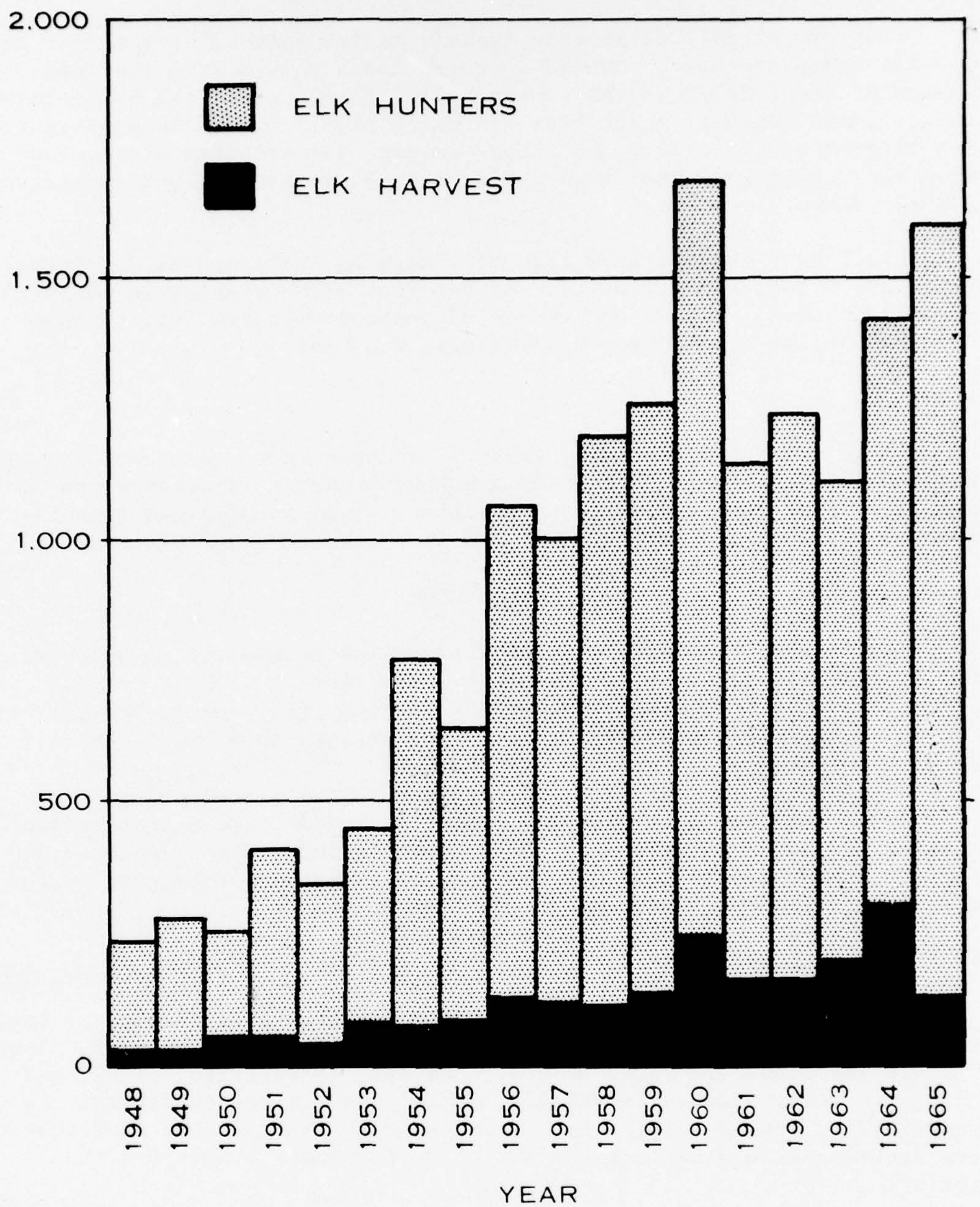



*Figure II-11 Estimated elk hunters and harvest, 1948-1965*

## Black Bear

Bear are classified as game animals in the National Forests of the Cascade Range and may be hunted on those lands only during the open season of about 2-1/2 months in the fall. Elsewhere in the basin there is no closed season. Black bear are quite highly valued by many sportsmen because of their meat and trophy values, and are commonly hunted when they congregate near higher-elevation berry patches and campground garbage dumps.

Black bear harvest in Willamette Basin is estimated at 800 annually. About 2,000 hunters derive 6,000 hunter-days of recreation in pursuit of this species. Others are killed to control predation and forest-tree damage, mostly in Lane and Columbia Counties.

## Cougar

It is estimated that only about 12 cougars have been taken annually in the basin in recent years. This number probably represents the annual natural increase of the population. This species has recently been classified as a game species and is protected under State law.

## Upland Game

Hunting for the basin's upland game birds is subject to seasonal and bag-limit restrictions. From the standpoint of numbers taken, pheasant are most popular, followed by dove, quail, pigeon, and grouse. In all, nearly 75,000 hunters take 343,000 upland game birds annually in about 316,000 hunter-days of recreation.

Small game mammals, except for gray squirrels, are unprotected. Rabbits and hares lead other small game in numbers taken. About 4,200 hunters spend more than 21,000 hunter-days to harvest more than 33,000 annually.

## Ring-Necked Pheasant

The most productive pheasant hunting is found on agricultural lands where mixed farming and interspersed brush provide ideal habitat. Typical hunting areas are found on Sauvie Island, in Tualatin Valley, and along the lower reaches of Molalla, Yamhill and Calapooia Rivers. In recent years, the general season has been more than 4 weeks in October and November with a daily bag limit of 2 or 3 cocks. Hens are protected.

It is estimated that about 41,500 hunters harvest 115,000 pheasants each year in the basin. This represents about 182,500 hunter-days of recreation. Willamette Basin provides about 14 percent of Oregon's pheasant harvest for 17 percent of the hunters.

*Photo II-65. Willamette Valley was the site of the first successful pheasant introduction in the United States. (Bureau of Sport Fisheries and Wildlife photo)*

Mourning Dove

Although the most popular dove-hunting areas in Oregon are east of the Cascades, there are large numbers of mourning doves in Willamette Valley. Most doves are hunted in the agricultural areas on the valley floor, usually in or near grain fields where they feed. In recent years the dove hunting season has been throughout September with a daily bag limit of 10 to 12 birds.

An estimated 8,400 hunters harvest an annual average of about 104,300 doves in Willamette Valley, providing an estimated 35,600 hunter-days of recreation. These figures represent about 2.5 percent of the dove hunter-days and harvest in Oregon.

Quail

Most hunting for valley and bobwhite quail occurs in the same area as pheasant hunting. Mountain quail are hunted in the foothills and forested areas of the basin, but have never been a very popular game species. The usual quail season in western Oregon is the same time and length as the general pheasant season, with a daily bag limit of 10 birds.

It is estimated that an average of 12,000 hunters harvest approximately 63,700 birds annually. This represents about 55,000 hunter-days of recreation. Most quail hunting is done incidental to pheasant hunting.

Band-tailed Pigeon

The most popular hunting areas for band-tailed pigeons are mineral springs which the birds prefer for watering. Pigeon season usually runs concurrently with the dove season in September, with a daily bag limit of eight.

In recent years, the number of hunters is estimated to average 6,400 with a harvest of about 44,800 birds annually. This represents 25,900 hunter-days of recreation annually. Willamette Basin provides nearly one-half of Oregon's pigeon harvest for about 40 percent of the hunters.

Grouse

Most grouse hunting takes place in the forested foothills. The usual season is 16 days with a daily bag limit of 3, but there was no open season in 1965 because of low populations.

An estimated 6,400 hunters harvest about 15,200 birds annually, providing 16,600 hunter-days of recreation.

Gray Squirrel

Although gray squirrels are classified as game animals, they are protected only in Benton, Linn and Lane Counties. The open season is generally about 2 months, September and October, with a bag limit of four. In the rest of the basin there is no closed season or bag limit. Gray squirrels are usually hunted near nut orchards or in stands of oak or other native nut species. In some nut orchards they have become a nuisance and require population control. An estimated 1,200 hunters harvest 5,400 gray squirrels and derive 6,400 hunter-days of recreation annually.

Rabbits and Hares

Native rabbits and hares are primarily forest and brush dwellers and are rarely numerous enough to provide high-quality hunting. Efforts to establish eastern cottontail in the basin were not notably successful. On occasion, rabbit populations may require control, particularly where they interfere with reproduction and regrowth on tree farms and on clear-cuts and burns in the forests. An estimated 3,000 hunters harvest 27,000 rabbits and hares in 15,000 hunter-days annually.

Opossum

Since opossum were introduced they have become a nuisance and population control measures are being conducted, particularly in Clackamas, Columbia and Marion Counties. Some opossum are also hunted for recreation, primarily at night with hounds. Their pelts are of limited value, with an annual average of only 165 being marketed in recent years. Average annual harvest of opossum is about 1,000.

## Waterfowl

Most duck and goose hunting occurs near low-elevation, permanent bodies of water, or in grainfields and pastures where the birds feed. Much waterfowl hunting takes place in special hunting areas, such as those maintained by Oregon State Game Commission at Sauvie Island, Fern Ridge Reservoir, and Camas Swale (Figure II-12), or at private hunting clubs scattered throughout the valley floor. In all, about 14,000 hunters spend 113,000 hunter-days to harvest about 10,000 geese, 74,000 pond ducks, and 1,000 diving ducks each year.

Season lengths and bag limits for waterfowl have been steadily reduced over the past half-century. Recently, the season has lasted 3 months with a daily bag limit of 4 ducks and 3 geese. Additional restrictions sometimes apply on bag limits for wood ducks, canvasbacks, hooded mergansers, and others.

## Furbearers

Based on the period 1961-65, the value of pelts harvested in Willamette Basin averaged more than $60,000 annually, and ranged from $50,000 to $80,000. Beaver provide about three-fourths of this total, with most of the remainder provided by mink, otter, raccoon, and nutria. Average values for single pelts are highest for otter, followed by beaver, mink, marten, and bobcat. Per-pelt values tend to fluctuate widely and have been very low in recent years.

### Raccoon

Because of their abundance, raccoon are not protected in Willamette Basin. Their pelt value is relatively low, fluctuating in response to fads and fashions. Cooperative control programs are being carried on where they are a nuisance, mostly in Benton, Yamhill, Clackamas, and Washington Counties. Raccoon are popular with off-season hunters, particularly for night hunting with hounds. About 2,000 raccoon are harvested annually in the basin. Of these, about 860 are pelted, bringing about $1,500.

### Muskrat

Although muskrat fur brings only a moderate price, the ease of trapping and pelting these animals makes them very popular with trappers. The open season is generally 3 months, from mid-November to mid-February. During recent years, the reported annual harvest of about 4,600 muskrats was worth an average of $3,800.

### Nutria

Nutria pelts are not very popular. In all, about 1,500 are harvested annually. Approximately 1,000 pelts are sold annually, and bring about $1,000. Since nutria compete with muskrats and beaver for available habitat, some attempt has been made to control their numbers and distribution, primarily in Benton and Marion Counties.

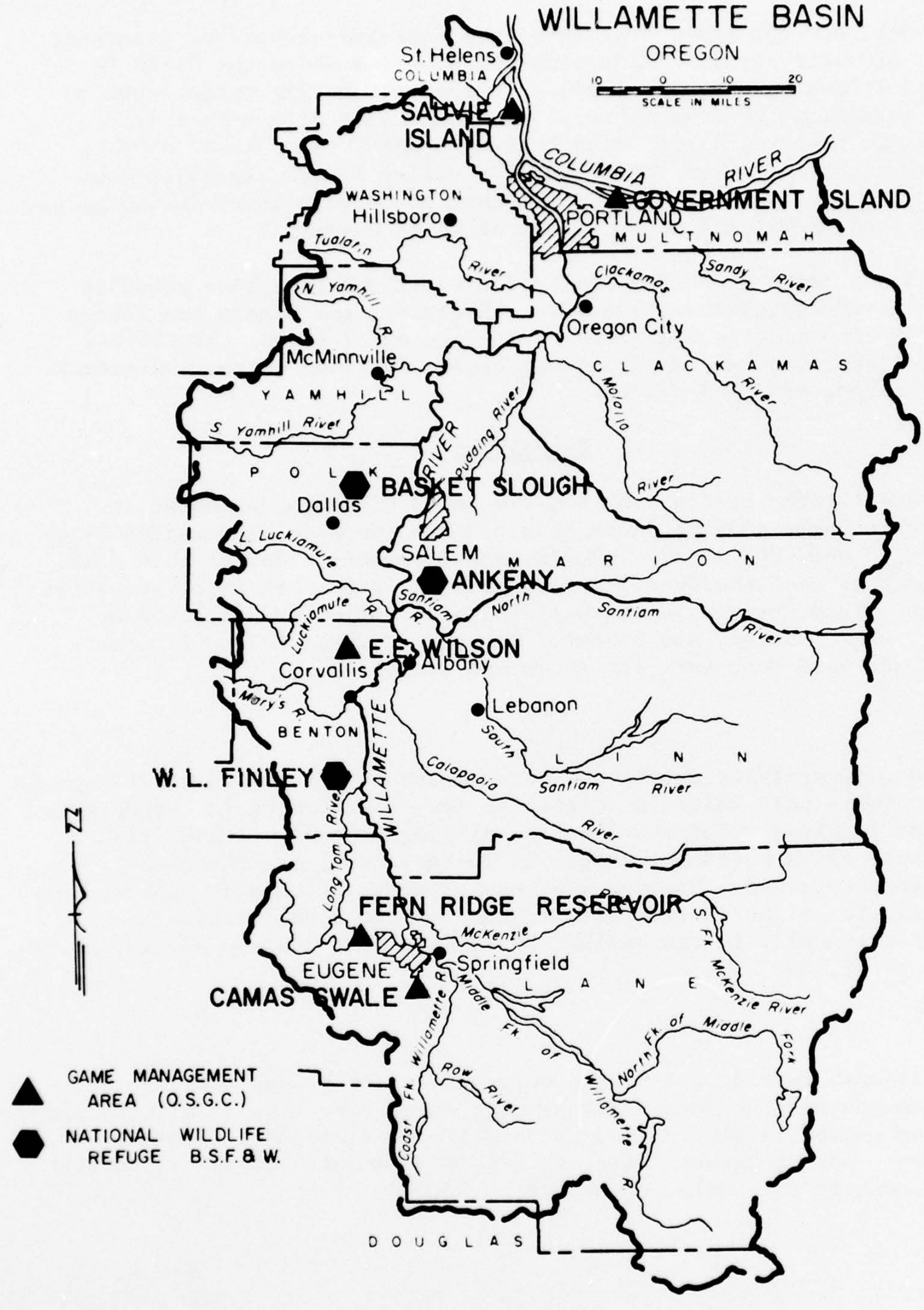



*Figure II-12. State and federal wildlife areas.*

*Photo II-66. Harvest from the marsh--a muskrat trapper with his morning's catch. (Bureau of Sport Fisheries and Wildlife photo)*

Beaver

Traditionally, beaver were the number-one furbearer of the Oregon Country. Their numbers reached lowest ebb during the late 1800's and trapping was prohibited from 1895 until 1951. Beaver occasionally damage trees or restrict waterways, and control measures, principally in-season trapping or removal to other areas, are then necessary. An average of nearly 4,500 pelts worth about $47,000 have been harvested annually in recent years.

Mink

Mink are fairly numerous in Willamette Basin and their fur is in demand. Trapping season lasts for 2 months, between mid-November and mid-January. Average annual harvest is about 670 pelts, worth almost $5,400.

Marten

Marten are quite scarce and very few are harvested each year. Trapping season generally runs from mid-November to mid-February.

Otter

Otter are relatively scarce, but their pelt value is high. More than 100 are harvested annually and their pelts are worth more than $2,200. In recent years, most of Willamette Basin has been open for a 3-month trapping season in winter.

## Predators

In most Willamette Basin counties, a mammal control agent regulates populations of predators, rodents, and other nuisance animals. Funds are provided cooperatively by the counties, the State of Oregon, and the Federal Government. The primary purpose of this program is to minimize destruction of domestic and game animals and crops.

Predator populations are controlled but not eliminated. In recent years two predators, black bear and cougar, have been reclassified as big game and hunting for these species is now regulated. Bald and golden eagles as well as other avian predators are completely protected. Predators are useful in game management because they keep rabbit and rodent populations down, and help prevent disease epidemics in other species.

### Foxes

Both red and gray foxes may cause damage by preying on domestic and game animals. Control agents have taken an average of over 700 of the 800 foxes harvested annually. Most of the foxes are taken in Linn, Clackamas, Yamhill, and Marion Counties. About 100 fox pelts have been sold annually in recent years. Hunters also pursue foxes for recreation.

### Coyote

Population control measures have been necessary to combat the rapid spread of coyotes in recent years. Of the annual take of about 500, over 480 were for population control, according to agents' reports. The majority of these were taken in Lane, Washington, Clackamas, and Linn Counties. The pelts are of low value and only a few are marketed each year. "Varmint" hunters find some off-season recreation in hunting coyotes.

### Bobcat

Of the average annual take of 320 bobcats in recent years, about three-fourths has been for population control and the remainder for pelts. Bobcats also provide a small amount of off-season recreational hunting.

### Eagles

Bald and golden eagles, because of their rarity, are protected. There is no need for organized population control measures; regulations provide for elimination of marauding individuals where damage incurred outweighs other values. The eagles' greatest value is esthetic.

*Photo II-67. Modoc National Wildlife Refuge, California. Most of the people that visit national wildlife refuges are not hunters or fishermen. (Bureau of Sport Fisheries and Wildlife photo)*

## Miscellaneous Species

Most of the birds and mammals discussed under this heading in the Inventory and Distribution section are not utilized in the sense that they are hunted or trapped. They do, however, occupy a place in the natural environment and are important to many people. The number of dedicated bird lovers in Willamette Basin is unknown, but there are probably more stores that sell wild birdseed than sell shotgun shells; more people that enjoy watching squirrels than are concerned about the nuts they consume. National Wildlife Refuge records indicate that most of the people that visit refuges are not hunters and fishermen, but come to observe the wildlife, hike, picnic, and take pictures of the birds and mammals.

## SUMMARY

Available information on Willamette Basin wildlife populations, ranges, utilization, and value is shown in Table II-64. These estimates are based on sample population counts, random hunter survey questionnaires, trapper reports, field checks of hunters, harvest data, and field observations. Some of the estimates are probably more reliable than others because it is difficult to determine wildlife populations precisely, but it is believed that the correct order of magnitude is shown.

Table II-64

*Ranges, populations, and utilization of Willamette Basin wildlife 1/*

| | Range (sq.mi.) | Population | Population Density (per sq.mi.) | Harvest | Harvest Density (per sq.mi.) | Hunters | Kill per Hunter | Mean Days Hunted | Daily Kill Per Hunter | Recreation in Man-Days |
|---|---|---|---|---|---|---|---|---|---|---|
| Deer | 11,900 | 135,000 | 11.3 | 29,400 | 2.5 | 65,700 | 0.45 | 4.7 | 0.095 | 310,300 |
| Elk | 2,700 | 2,000 | 0.7 | 200 | 0.07 | 1,400 | 0.15 | 6.1 | 0.025 | 8,000 |
| Bear | 8,300 | 14,000 | 1.7 | 800 | 0.10 | 2,000 | 0.4 | 3 | 0.14 | 6,000 |
| Gray squirrel | 5,000 | 50,000 | 10 | 5,400 | 1.1 | 1,200 | 4.4 | 5.2 | 0.8 | 6,400 |
| Rabbits and hares | 8,000 | 240,000 | 30 | 27,000 | 3.5 | 3,000 | 9 | 5 | 1.8 | 15,000 |
| Mourning dove | 4,400 | 500,000 | 114 | 104,300 | 23.7 | 8,400 | 12.4 | 4.4 | 2.9 | 35,600 |
| Band-tailed pigeon | 6,600 | 200,000 | 30 | 44,800 | 6.8 | 6,400 | 7.0 | 4.0 | 1.7 | 25,900 |
| Pheasant | 3,700 | 400,000 | 108 | 115,000 | 31.1 | 41,500 | 2.8 | 4.4 | 0.6 | 182,500 |
| Quail | 7,000 | 220,000 | 31 | 63,700 | 9.1 | 12,000 | 5.3 | 4.6 | 1.2 | 55,000 |
| Grouse | 9,000 | 65,000 | 7.2 | 15,200 | 1.7 | 6,400 | 2.4 | 2.6 | 0.9 | 16,600 |
| Ducks | 1,000 | 177,700 | 177.7 | 75,000 | 75.0 | 14,000 2/ | 9.1 2/ | 6.7 2/ | 1.3 2/ | 113,000 2/ |
| Geese | 400 | 14,400 | 36.0 | 10,000 | 25.0 | | | | | |
| Miscellaneous | - | - | - | - | - | 20,000 | - | 4 | - | 80,000 |
| Bobcat | 9,100 | 5,000 | 0.5 | 320 | 0.04 | | | | | |
| Cougar | 7,100 | 50 | 0.007 | 12 | 0.002 | | | | | |
| Otter | 3,200 | 500 | 0.2 | 110 | 0.03 | | | | | |
| Mink | 11,800 | 10,000 | 0.8 | 670 | 0.06 | | | | | |
| Fisher | 400 | 0 | | 0 | | | | | | |
| Marten | 2,000 | 1,000 | 0.5 | 4 | 0.002 | | | | | |
| Raccoon | 9,700 | 50,000 | 5.2 | 2,000 | 0.21 | | | | | |
| Foxes | 6,000 | 12,000 | 2.0 | 800 | 0.13 | | | | | |
| Coyote | 11,700 | 5,000 | 0.4 | 500 | 0.04 | | | | | |
| Nutria | 900 | 20,000 | 22.2 | 1,500 | 1.7 | | | | | |
| Muskrat | 2,500 | 50,000 | 20.0 | 4,600 | 1.8 | | | | | |
| Beaver | 3,200 | 10,000 | 3.1 | 4,500 | 1.4 | | | | | |
| Opossum | 2,300 | 20,000 | 8.7 | 1,000 | 0.43 | | | | | |
| | | | | | | | | | Total | 854,300 |

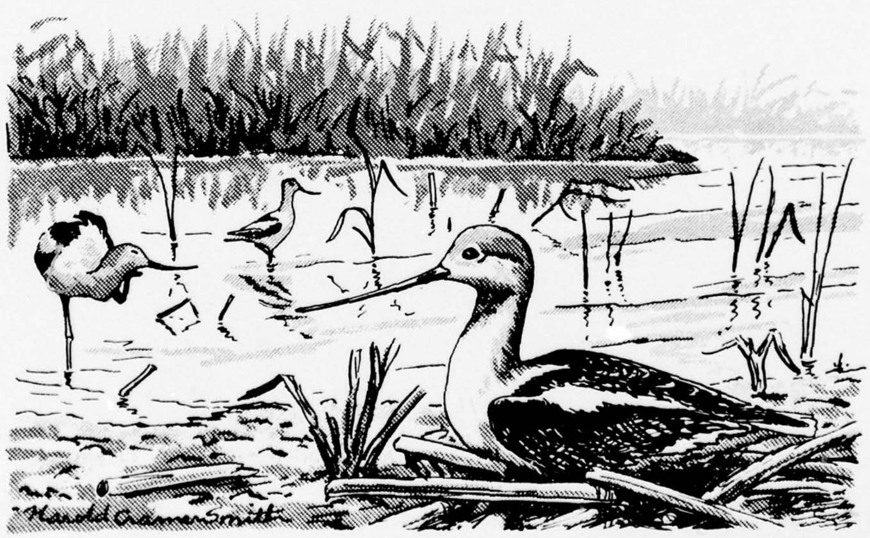
1/ *Estimates based on 1961 to 1965 concentration area counts, hunter survey questionnaires, trappers reports, hunter field checks, harvest surveys, population trend surveys and field observations. Includes population control harvest, recreational harvest, and commercial harvest where applicable.*

2/ *This figure includes ducks and geese.*

## MANAGEMENT PROBLEMS

Effective management of wildlife populations to realize their full potential is accomplished primarily by manipulating harvest and habitat. Of these, harvest is the easier to control. Present hunting and trapping regulations represent nearly the maximum of management attainable by this means. The regulations are revised as changes in wildlife populations and habitat are observed. Wildlife research and improvements in population-survey methods may permit liberalizing the harvest for the few species whose hunting and trapping seasons are now based on meager data.

The greatest potential for increasing wildlife populations in Willamette Basin lies in properly managing habitat; such increases are now taking place. Elk, deer, pheasant, quail, and waterfowl populations increase most readily under proper habitat manipulation. For example, elk populations expand where logging increases the amount of forage available in their winter range during critical periods. The range and numbers of deer also have been increased by clear-cuts in critical habitat areas. Pheasant and quail benefit from cover and food planted and maintained on farmland in the valley, and waterfowl are being helped through wetland development and preservation.



Specific increases of wildlife populations have resulted from proper water management in many cases. For example, reservoirs with stable water levels may promote increases in pond duck nesting and production, and in muskrat populations. Stabilized streamflows benefit beaver and otter populations and duck production. Wetland habitat suitable for waterfowl and many fur bearers is being preserved and increased by private individuals and governmental entities who are acquiring land and constructing impoundments. Generally, the species which have suffered most in the past from improper water management stand to gain most in the future from the measures now being taken to preserve and develop suitable water supplies and wetland habitat.

In wildlife management, environmental factors which limit wildlife populations are controlled to the extent possible. Some of these by their very nature cannot be controlled, i.e. climate, the natural tendency of some species to have recurring population cycles, and weather during critical periods such as bird nesting seasons. Other factors, such as food supply, habitat destruction, diseases and water pollution, are controllable and management efforts are directed to them. Particular attention is paid to achieving a harmonious balance among the various controllable factors, because habitat quality is the most significant general limit on wildlife populations in Willamette Basin. Other controllable factors in wildlife management are less far-reaching than habitat quality, but are of great importance in the management of certain species.

*Photo II-68. Waterfowl hunters in a Willamette Valley pit blind. (Oregon State Game Commission photo)*

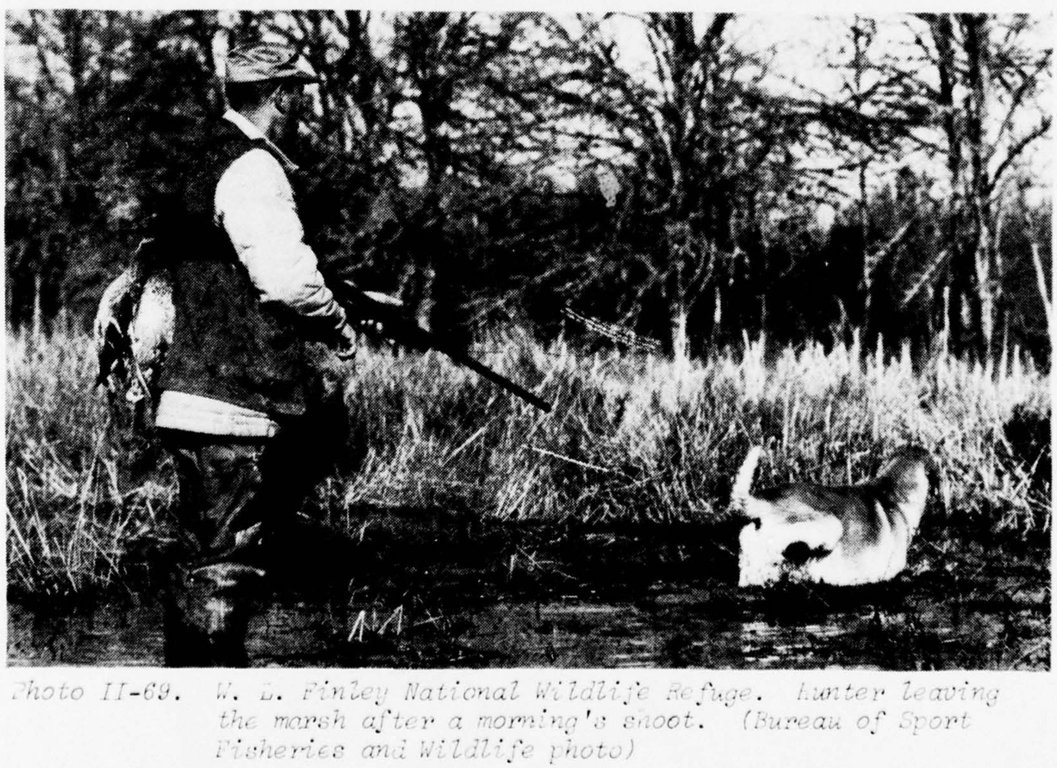


*Photo II-69. W. L. Finley National Wildlife Refuge. Hunter leaving the marsh after a morning's shoot. (Bureau of Sport Fisheries and Wildlife photo)*

Habitat quality is defined as the indistinct relationship among food, cover, and water that determines the total productivity of the habitat. Populations decrease due to poor-quality habitat when food, cover, and water are not present in the proper physical relationship during periods of stress. Habitat quality can be controlled and improved by planting food and cover, augmenting water supplies, protecting the habitat, using proper agricultural practices, maintaining streamflows, acquiring lands for wildlife, and informing landowners about the wildlife habitat quality requirements.

## DEVELOPMENTS AFFECTING WILDLIFE

The works of man affect wildlife populations either for their benefit or detriment according to their ecological requirements. Some of the more significant developments which have changed wildlife environments in Willamette Basin include:

### Water Storage Developments

The construction of reservoirs in Willamette Basin has had many important effects on wildlife populations. Fern Ridge Reservoir created extensive wetlands of value to both waterfowl and furbearers, although this benefit is partially negated by fluctuating storage levels which flood out nesting waterfowl. Valuable winter range for black-tailed deer has been inundated by Hills Creek, Cougar, and Detroit Reservoirs, Timothy Lake and other impoundments.

*Photo II-70. Fern Ridge Reservoir created extensive wetlands of value to both waterfowl and furbearers. (Corps of Engineers photo)*

## Stream Channelization

Stream channelization, river dredging, and bank revetment have adversely affected wildlife populations (Photo II-71). On Long Tom River, for example, channel straightening has reduced furbearer and pond duck habitat by eliminating many miles of streambank habitat and cover. Channelization and straightening of Camas Swale Creek has resulted in a loss of summer water flows because of rapid runoff. Pond duck usage of the area has decreased. Dredging of Columbia and Willamette Rivers has destroyed waterfowl habitat by filling adjacent marshes with spoil. Mocks Bottom, a water area of 200 to 300 acres once used by resting waterfowl, has been filled for industrial use (Photo II-72).

## Pollution

Pollution has reduced wildlife populations, particularly furbearers such as beaver and otter, along certain streams. The most critical water pollution areas are in lower Willamette and South Santiam Rivers.

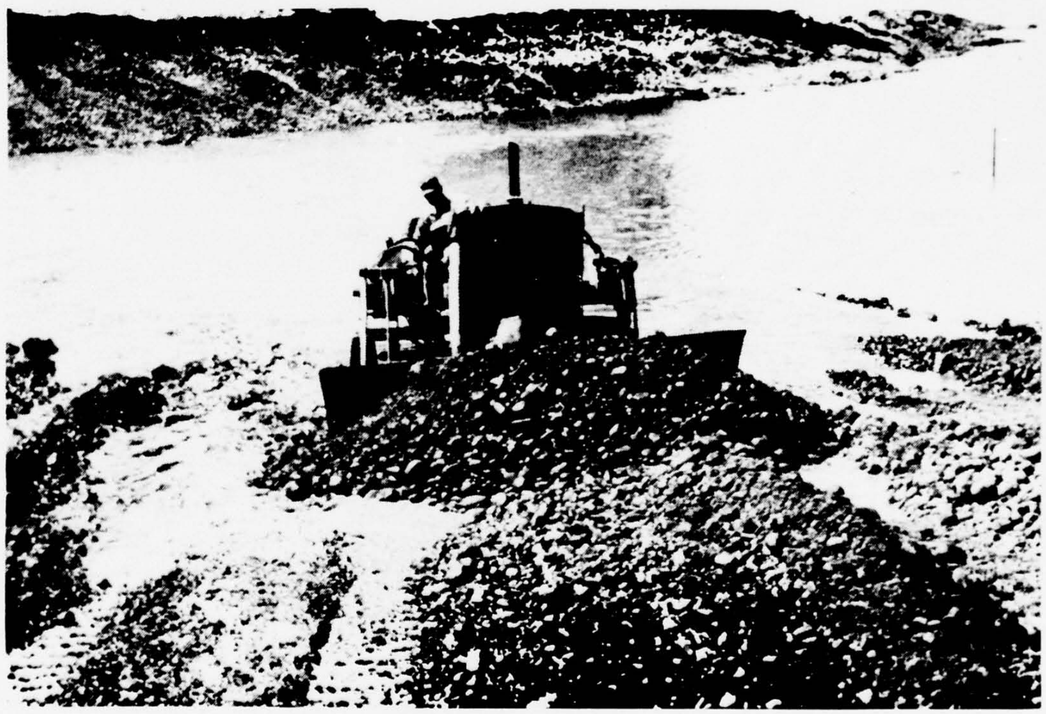


*Photo II-71. Stream channelization, Crabtree Creek, Santiam drainage. Such operations as this destroy habitat for fur, fish, and game. (Oregon State Game Commission photo)*

*Photo II-72. Junction of Willamette and Columbia Rivers. Undeveloped area, center foreground, is scheduled for extensive industrial development. Mock's Bottom, right center, has already been destroyed.*

## Wetland Drainage

Diking, filling and draining marshes and ponds have reduced the wetland habitat. Waterfowl and several furbearers have been directly affected and associated habitat for upland game has been lost. Some of this loss has been partially offset by nesting habitat created along ditch banks associated with drainage projects. One area of wetland drainage that has directly affected pond duck numbers lies between Creswell and Cottage Grove along Interstate 5, where several sloughs and potholes were drained or filled during highway construction and farmland reclamation operations.

## Urbanization

Rapid growth of the metropolitan areas of Willamette Basin has had direct and visible effects on the wildlife environment. Numbers of pheasants and other upland game, waterfowl, furbearers, and big game have all declined as a result of this loss of habitat, particularly around the Eugene-Springfield and the Portland metropolitan areas. In recent years, many thousands of acres of highly productive wildlife habitat have been irreplaceably lost to urban expansion.

## Industrial Development

Industrial expansion also has directly affected wildlife by taking over productive habitat. Indirectly, industry has polluted water and reduced habitat quality in many areas. For example, industrial pollution of North Santiam River below Stayton has drastically reduced furbearer populations, particularly beaver, in this reach. Along Highway 99 north of Eugene waterfowl and upland game have been lost where industrial developments have occupied valuable habitat and have caused pond duck mortality by discharging chemicals into nearby ditches and ponds.

## Logging

The sum effect of most logging has been to increase valuable wildlife habitat. Black-tailed deer, elk, grouse, and quail all benefit when logging opens up stands of mature, closed-canopy timber for the growth of food and cover. Some of the most popular deer and elk hunting areas are found where properly scattered clear-cuts have created plant successional stages which greatly increase browse and forage. On the other hand, improper logging practices have choked streams with debris and silt, altered runoff rates, and delayed habitat recovery, all to the detriment of aquatic and forest furbearers, game birds, and big game. (Photo II-73).

*Photo II-73. Improper logging practices have seriously reduced the quantity and quality of stream habitat in this area of Tally Creek, tributary to the Middle Santiam River. (Oregon State Game Commission photo)*

## Highways and Roads

Upland game populations are reduced whenever a new highway or road is constructed through productive habitat, such as when Interstate Highway 5 was constructed through the valley. Also, as a less important side effect, the rate of road kills is higher on high-speed highways and along paved county roads. In several counties, road crews use herbicide sprays extensively to control weeds and brush, destroying productive roadside cover along the county road networks.

## Agriculture

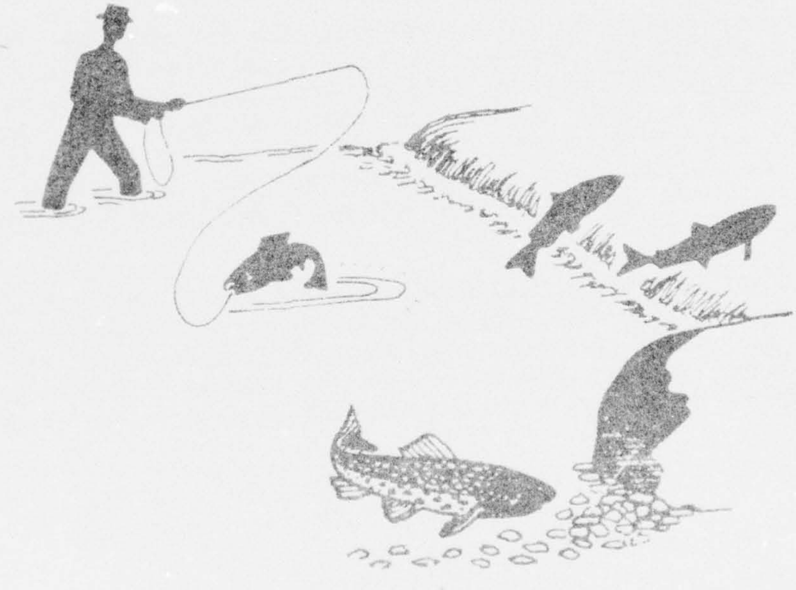
Many modern farming practices have been detrimental to wildlife habitat. In the past, the farmer was a benefactor to upland game because his farming, cropping, and fencing practices created small brush patches and coverts. In recent years, there has been a serious loss of game numbers, food, and cover where burning, spraying, and clean farming have been practiced. For example, extensive rye grass farming has reduced game populations by such practices as field and edge burning, and by the use of agricultural chemicals. In orchard areas, use of insecticides has had both direct and indirect effects on the wildlife numbers and productivity.

## Developments Specifically for Wildlife

A limited amount of habitat designed specifically for wildlife has been installed on private land under the Agricultural Stabilization and Conservation Program of the U. S. Department of Agriculture. Some habitat also has been developed by private individuals without subsidy payment. Many private "duck" clubs have been established. Most of these are unimproved natural areas on which hunting is leased to one or more individuals, but a few, particularly on goose feeding areas, have been developed specifically to attract waterfowl. They are open to the public on a fee basis, and have been quite successful in attracting both waterfowl and hunters.

Oregon State Game Commission has acquired and developed 5 wildlife management areas in the basin, primarily for waterfowl, and the Bureau of Sport Fisheries and Wildlife is in process of acquiring and developing three small wildlife refuges. Hunting on these areas is severely rationed because of the great demand for waterfowl hunting, and on the State areas a small fee is charged.

# FISH



## GOALS

The basic goal of agencies planning for fish in Willamette Basin is to conserve and enhance the fish habitat in order that future demands for the resource may be satisfied to the greatest possible degree. This will aid in supplying needs, wants, and desires of the people for leisure-time activities, aesthetic enjoyment of natural beauty, increased supplies of food, and general economic betterment. The requirements for reaching this goal involve maintaining at least the present catch-per-unit-of-effort for sport fishing, and continuing the present ratio of sport to commercial catch.

## PROJECTED DEMAND FOR FISH

Specific minimum goals estimated for spring and fall chinook salmon, coho salmon, and winter and summer steelhead trout are shown as "demands" in the following tables. It is assumed that since each species and race of salmon or steelhead is caught during a different season, or in a different location, the demand for any one species (or race) could be satisfied only by that species (or race). Minimum goals for warm-water fish and resident trout are also estimated. These two groups contain several species which could interchangeably satisfy the same demand, so specific goals for these species are not estimated. Information from which to establish goals for American shad, white sturgeon, and searun cutthroat trout is not available.

### Anadromous Fish

The future demand for salmon and steelhead for the sport fishery is based on present-use data (Part II), expected changes in the per capita fishing participation rate from 1965 to 1980, and the changes in population from 1965 to 2020. Population changes are based on projections in Appendix C - Economic Base. Changes in the per capita fishing participation rate are based on national averages for all types of sport fishing as reported in the National Survey of Fishing and Hunting for 1955, 1960, and 1965.

Demand for salmon and steelhead, in terms of numbers of fish, is calculated by applying catch-to-escapement and sport-to-commercial ratios (in the following tabulation) to sport fishery demand figures. These are approximate present ratios and, in line with minimum goals, it is assumed that they will remain constant throughout the projection period:

| Species | Catch to Escapement | Angler Days Per Fish | Sport to Commercial |
|---|---|---|---|
| Spring chinook salmon | 4:1 | 8 | 1:2 |
| Fall chinook salmon 1/ | 6:1 | 5 | 1:3 |
| Coho salmon | 3:1 | 1 | 1:4 |
| Winter steelhead trout | 1:4 | 8 | 2:1 |
| Summer steelhead trout 1/ | 2:1 | 8 | 1:1 |

1/ *The participation rate is assumed to be the same as the rate for spring chinook salmon.*

The present harvest and projected future demands for the commercial catch are presented in Table III-1.

Table III-1
*Projected annual demand for commercial fish*
*(thousands)*

| Species | Commercial Catch (Fish) 1980 | 2000 | 2020 | Commercial Catch (Pounds) 1980 | 2000 | 2020 |
|---|---|---|---|---|---|---|
| S. chinook | 177 | 242 | 359 | 3,003 | 4,115 | 8,096 |
| F. chinook | 424 | 581 | 861 | 7,208 | 9,878 | 14,630 |
| Coho | 254 | 348 | 515 | 1,776 | 2,433 | 3,604 |
| W. steelhead | 4 | 5 | 8 | 39 | 59 | 80 |
| S. steelhead | 44 | 61 | 90 | 397 | 545 | 807 |

The current use and projected demands by sport fishermen in number of fish and angler-days are shown in Table III-2.

Table III-2
*Projected annual demand for anadromous sport fish*
*(thousands)*

| Species | Sport Catch (Fish) 1980 | 2000 | 2020 | Sport Fishing (Angler-Days) 1980 | 2000 | 2020 |
|---|---|---|---|---|---|---|
| S. chinook | 88 | 121 | 179 | 707 | 968 | 1,434 |
| F. chinook | 141 | 194 | 287 | 707 | 968 | 1,434 |
| Coho | 63 | 87 | 129 | 63 | 87 | 128 |
| W. steelhead | 8 | 11 | 16 | 63 | 86 | 128 |
| S. steelhead | 88 | 121 | 179 | 707 | 968 | 1,434 |

## Resident Fish

The goal for resident fish is to maintain average catch-per-unit-of-effort for trout at the present rate of 2.5 fish per day and for warm-water game fish at 3.0 fish per day. Demand in terms of numbers of fish and angler-days for resident Willamette Basin sport fish is shown in Table III-3.

Table III-3
*Projected annual demand for resident sport fish*
*(units in thousands)*

| Type | Angler-Days 1980 | Angler-Days 2000 | Angler-Days 2020 | Catch (fish) 1980 | Catch (fish) 2000 | Catch (fish) 2020 |
|---|---|---|---|---|---|---|
| Trout | 1,100 | 1,500 | 2,200 | 2,800 | 3,800 | 5,500 |
| Warmwater | 300 | 400 | 500 | 900 | 1,200 | 1,500 |

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## PROJECTED SUPPLY OF FISH

The quantity of anadromous fish by species that can be supplied is projected for 1980, 2000, and 2020. Supply of each species is expected to reach its peak by 2000 and remain there through 2020. It is assumed that production of artificially-produced anadromous fish will be constant throughout the projection period. Table III-4 shows the projected supply of anadromous fish under the conditions indicated.

The future supply of resident fish is assumed for purposes of this study to remain constant. Thus, an increase in any of the four following factors would serve to increase the supplies: (1) stocking of hatchery-produced fish, (2) angler access to areas presently posted against trespass or to areas without adequate facilities (such as boat-launching sites and parking areas), (3) improvement and maintenance of habitat, or (4) production in private fish ponds. Natural populations of resident fish are not calculated, but these are generally low in relation to anticipated future demand.

## Anadromous Fish

The future supply, estimated for each of the salmon and steelhead trout runs entering the basin's streams, is shown in Table III-4. Insufficient time has elapsed since fishways were improved at Willamette Falls to allow runs to build up to their potential. Therefore, stream-carrying capacities are estimated by comparing them with similar streams believed to already be at their full carrying capacities. The supply is calculated to reach these carrying capacities by 2000 and remain at this level. The fish supply was projected from 1965 to 2000 using a straight-line relationship between time and increasing numbers of fish. Stream-carrying capacities for each anadromous species are determined as follows.

Table III-4

*Projected anadromous fish supply in terms of escapement, commercial and sport catch, 1980, 2000, 2020*

| | | Escapement | | | Commercial Catch 1/ | | | Sport Catch 1/ | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Subbasin | Species | Base Year 2/ | 1980 | 2000 and 2020 1/ 3/ | Base Year | 1980 | 2000 and 2020 | Base Year | 1980 | 2000 and 2020 |
| Willamette Basin Total (Stream Spawning and Hatchery Production) 4/ | S. Chinook | 36,500 | 42,000 | 47,000 | 97,000 | 112,000 | 126,000 | 49,000 | 56,000 | 63,000 |
| | F. Chinook | 7,300 | 63,000 | 119,000 | 33,000 | 284,000 | 535,000 | 11,000 | 95,000 | 178,000 |
| | Coho | 58,000 | 70,000 | 82,000 | 140,000 | 168,000 | 196,000 | 35,000 | 42,000 | 49,000 |
| | W. Steelhead | 26,000 | 41,000 | 56,000 | 2,200 | 3,400 | 4,700 | 4,300 | 6,800 | 9,400 |
| | S. Steelhead | - | 6,400 | 13,000 | - | 4,300 | 8,500 | - | 8,500 | 17,000 |
| Willamette Basin Stream Spawning 5/ | S. Chinook | 27,000 | 33,000 | 38,000 | 73,000 | 87,000 | 101,000 | 36,000 | 44,000 | 51,000 |
| | F. Chinook | 1,000 | 57,000 | 113,000 | 4,500 | 255,000 | 507,000 | 1,500 | 85,000 | 169,000 |
| | Coho | 34,000 | 46,000 | 58,000 | 82,000 | 111,000 | 139,000 | 21,000 | 28,000 | 35,000 |
| | W. Steelhead | 24,000 | 39,000 | 54,000 | 2,000 | 3,300 | 4,500 | 4,000 | 6,500 | 9,000 |
| | S. Steelhead | - | 6,400 | 13,000 | - | 4,300 | 8,500 | - | 8,500 | 17,000 |
| Willamette Basin Hatchery Production | S. Chinook | 9,200 | 9,200 | 9,200 | 25,000 | 25,000 | 25,000 | 12,000 | 12,000 | 12,000 |
| | F. Chinook | 6,300 | 6,300 | 6,300 | 28,000 | 28,000 | 28,000 | 9,400 | 9,400 | 9,400 |
| | Coho | 24,000 | 24,000 | 24,000 | 57,000 | 57,000 | 57,000 | 14,000 | 14,000 | 14,000 |
| | W. Steelhead | 2,000 | 2,000 | 2,000 | 170 | 170 | 170 | 340 | 340 | 340 |
| | S. Steelhead | - | - | - | - | - | - | - | - | - |

1/ *Based upon the present ratios of catch to escapement and the sport to commercial catch.*

2/ *The base year for natural and hatchery escapement of spring chinook salmon is an average for 1962 through 1964. For natural escapement of fall chinook and coho salmon, the base year is 1965. Cedar Creek Hatchery escapement of coho salmon for the base year is the average for 1962 through 1965. Eagle Creek Hatchery escapement for coho was 1962 through 1964. The base year for natural escapement of winter steelhead trout was 1966, while for hatchery escapement it was the 1963 through 1966 average.*

3/ *Estimates by Fish Commission of Oregon.*

4/ *These totals are rounded. The subbasin figures are also rounded; consequently, their sums do not always equal the Willamette Basin totals.*

5/ *Carmen-Smith Spawning Channel was included as a stream spawning area.*

Spring chinook salmon. Accessible spawning and rearing habitat for this species is now being used. In the future, better production is expected because of lessened delay of adults at Willamette Falls; and the screening of diversions will increase survival of juveniles as will the improvement of downstream passage at Willamette Falls. The future carrying capacity is estimated to be present spawning escapement plus an allowance for improved conditions.

The total spawning escapement in 1980 is projected to be over 42,000 spring chinook salmon, with 33,000 spawning in streams and 9,200 spawned artificially in fish hatcheries. The annual Willamette Basin spawning escapement for 2000 and 2020 is projected to be 47,200 spring chinook salmon, of which 38,000 will spawn in streams and the remainder will be spawned in hatcheries.

Fall chinook salmon. The future supply of fall chinook salmon is estimated by comparing Willamette Basin streams to those of the Sacramento and Columbia River systems, particularly Kalama River. Three types of streams are used for comparison: (1) streams with flow, passage, and diversion problems; (2) streams with no problems and good spawning areas; and (3) streams with large reservoirs and partially controlled flows. The number of spawners per mile, averaged for each of the three situations, is applied to the appropriate streams in the basin.

More refined estimates were made by using a comparison of catch-to-escapement ratios for the Columbia and Sacramento Rivers, and by applying a factor representing the effects of future screening.

Spawning escapement of fall chinook salmon is projected to reach 63,000 fish annually by 1980 and 119,000 fish by 2000, after which escapement is expected to remain constant through 2020. Bonneville Hatchery on Tanner Creek is the only Willamette Basin hatchery producing significant numbers of fall chinook salmon, handling an annual escapement of about 6,300 adults.

Coho salmon. Physical characteristics of Willamette Basin streams with suitable potential for coho salmon were compared with streams in the Tualatin and Nehalem River systems presently producing coho salmon. The data used included estimates of the number of fingerlings per unit of pool area at the end of the summer in the Tualatin and Nehalem systems. These data were applied to pool areas for Willamette Basin streams and a 33 percent reduction factor was applied for winter mortality to determine the potential smolt population. Potential adult coho returns were based on a 2.5 percent ocean survival of smolts. Although other studies have shown

a 3 percent ocean survival, Willamette Basin fish have longer migrations and face more hazards than the shorter-run fish of the other studies.

*Photo III-1. Salmon fishing downstream from Willamette Falls. (Oregon State Highway Commission photo)*

By 1980, the spawning escapement of coho salmon is projected to reach 70,000 fish, of which 24,000 will return to fish hatcheries. The 2000 and 2020 potential spawning escapement is projected to be 82,000 annually. Of this escapement, 24,000 will go to fish hatcheries.

Winter steelhead trout. Only a few streams in Willamette Basin, including Little North Santiam River upstream from Elkhorn Falls, and North Scappoose Creek upstream from Bonnie Falls, are believed to be producing winter steelhead at or near their potential carrying capacities. For these streams, present carrying capacities are used as the potential. For all other streams, carrying capacity was calculated by proportion, with the assumption that such streams would reach the same carrying capacity per unit of stream area as now exists in the streams that are producing at or near their potential. In most cases, streams with potential for summer steelhead production are not considered to have winter steelhead potential.

By 1980, the spawning escapement of winter steelhead trout is projected to reach 41,000 fish, with 2,000 entering fish hatcheries. The potential spawning population of winter steelhead trout from 2000 to 2020 is projected at 56,000 fish annually, with 2,000 returning to fish hatcheries.

Summer steelhead trout. Only streams with the highest-quality summer flows and water temperatures have potential for summer steelhead trout. Potential production was calculated in the same manner as for winter steelhead. Summer steelhead are generally considered to be more valuable to sport fishermen than winter steelhead, because they are available to fishermen for a longer period of time and also because they enter the rivers during the summer when there is better weather. These fish have already been introduced into Willamette Basin by the Oregon State Game Commission.

The annual spawning escapement is projected to reach 6,400 fish by 1980 and 13,000 fish annually from 2000 through 2020. None of the fish hatcheries in Willamette Basin presently produce these fish.

## Resident Fish

The estimated supply of resident fish, and the demand for these fish, are based on a 1965 survey of fisherman-use and catch conducted by Oregon State University for this study. Demand data are projected in line with trends calculated from the 1955, 1960, and 1965 Survey of Fishing and Hunting, and in line with population projections in the Economic Base Appendix. Since the habitat for trout and the hatchery production of trout are assumed to remain constant throughout the period of study, Table III-6 shows a constant supply of these fish during the study period.

Supply of warm-water fish is likewise more-or-less fixed by the amount of habitat in the basin. However, much of this supply is not available to fishermen because access to many lakes and streams supporting warm-water fish is restricted. The available supply may be increased as demand increases by accelerating fisherman access and other management programs of Oregon State Game Commission to bring underutilized or underproducing waters into full production.

## Assumptions

In projecting the quantity of fish available in the future, it was assumed that:

1. The effect of Willamette Falls fishway in increasing runs of existing and introduced anadromous fish will be fully realized by 2000.

2. Anadromous fish catch-to-escapement ratios will remain constant throughout the study period.

3. Major pollution will be controlled to a point that uninhibited passage is possible for fish.

4. Fish passage at all minor manmade barriers and all necessary screening will be accomplished by 1980.

5. Storage of water throughout Willamette Basin will smooth out the extremes of streamflow as compared to those of the past.

6. Potential anadromous fish escapement for each stream is a function of the carrying capacity of that stream, which in turn is dependent upon the physical dimensions and characteristics of areas having suitable water quality (including temperature).

7. Carrying capacity for a stream may be determined by comparison with carrying capacity data obtained from a similar stream.

8. Downstream-migrant anadromous fish will enter unscreened diversions in direct proportion to the volume of flow diverted.

9. Artificial propagation of resident and anadromous fish will remain constant at present levels. (Possible increases in artificial propagation facilities are considered in Part IV.)

10. High lakes in Willamette Basin are underfished and they will continue to provide high-quality fishing throughout the study period.

11. Nongame-fish control will remain a major policy of fishery agencies.

12. Production of wild populations of trout will not increase at significantly more than the present rate.

13. Warm-water game fish are underfished. With improved management, including access to fishing areas, these species will provide high-quality fishing throughout the study period.

14. There will be no changes in the present fish habitat except as mentioned in the other assumptions.

15. The anadromous fish habitat lost upstream from any future dam will be adequately compensated for by means that will neither reduce the numbers of fish presently produced in the areas upstream from the dam, nor reduce benefits creditable to downstream areas.

## UNSATISFIED DEMAND

### Anadromous Fish

The annual supply of all types of anadromous fish is expected to fall short of projected demand throughout the study period. The percent of supply available relative to demand is shown in the following tabulation:

| Anadromous Fish | 1980 | 2000 | 2020 |
|---|---|---|---|
| Spring chinook salmon | 63 | 52 | 35 |
| Fall chinook salmon | 67 | 92 | 62 |
| Coho salmon | 66 | 56 | 38 |
| Winter steelhead trout | 83 | 84 | 51 |
| Summer steelhead trout | 10 | 14 | 10 |

Table III-5 shows the projections of demand, supply, and unsatisfied demand for anadromous fish over the period of study.

*Table III-5*
*Projected total demand, supply, and unsatisfied demand for anadromous fish, 1980-2020*
*(thousands of fish)*

| Species | 1980 | | | 2000 | | | 2020 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Demand | Supply 1/ | Unsatisfied Demand | Demand | Supply 1/ | Unsatisfied Demand | Demand | Supply 1/ | Unsatisfied Demand |
| Spring chinook | | | | | | | | | |
| Spawning escapement | 66 | 42 | 24 | 91 | 47 | 44 | 134 | 47 | 87 |
| Commercial catch | 177 | 112 | 65 | 242 | 126 | 116 | 359 | 126 | 233 |
| Sport catch | 88 | 56 | 33 | 121 | 63 | 58 | 179 | 63 | 116 |
| Fall chinook | | | | | | | | | |
| Spawning escapement | 94 | 63 | 31 | 129 | 119 | 10 | 191 | 119 | 72 |
| Commercial catch | 424 | 284 | 140 | 581 | 535 | 46 | 861 | 535 | 326 |
| Sport catch | 141 | 95 | 46 | 194 | 178 | 16 | 287 | 178 | 109 |
| Coho | | | | | | | | | |
| Spawning escapement | 106 | 70 | 36 | 148 | 82 | 66 | 215 | 89 | 133 |
| Commercial catch | 254 | 168 | 86 | 348 | 196 | 152 | 515 | 196 | 319 |
| Sport catch | 63 | 42 | 21 | 87 | 49 | 38 | 129 | 49 | 80 |
| Winter steelhead | | | | | | | | | |
| Spawning escapement | 47 | 41 | 6 | 65 | 56 | 9 | 96 | 56 | 40 |
| Commercial catch | 4 | 3 | 1 | 5 | 5 | 0 | 8 | 5 | 3 |
| Sport catch | 8 | 7 | 1 | 11 | 9 | 2 | 16 | 9 | 7 |
| Summer steelhead | | | | | | | | | |
| Spawning escapement | 66 | 6 | 59 | 91 | 13 | 78 | 134 | 13 | 121 |
| Commercial catch | 44 | 4 | 40 | 61 | 9 | 15 | 90 | 9 | 81 |
| Sport catch | 88 | 9 | 79 | 121 | 17 | 104 | 179 | 17 | 162 |

1/ *Supply with Willamette Falls Fishway complete, passage at all minor man-made barriers, screening of all diversions, present flow conditions, and pollution control in the lower Willamette River.*

Table III-6

*Projected total demand, supply, and unsatisfied demand for resident fish, 1980-2020*

*(thousands of fish)*

| (Fish type) | Willamette Basin Subarea | 1980 | | | 2000 | | | 2020 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Quantity Demanded | Quantity Supplied | Unsatisfied Demand | Quantity Demanded | Quantity Supplied | Unsatisfied Demand | Quantity Demanded | Quantity Supplied | Unsatisfied Demand |
| Trout | | | | | | | | | | |
| | Lower | 770 | 520 | 250 | 1,040 | 520 | 520 | 1,500 | 520 | 980 |
| | Middle | 730 | 490 | 240 | 980 | 490 | 490 | 1,430 | 490 | 940 |
| | Upper | 1,300 | 890 | 410 | 1,780 | 890 | 890 | 2,570 | 890 | 1,680 |
| | Total | 2,800 | 1,900 | 900 | 3,800 | 1,900 | 1,900 | 5,500 | 1,900 | 3,600 |
| Warm-water | | | | | | | | | | |
| | Lower | 300 | 180 | 120 | 410 | 180 | 230 | 510 | 180 | 330 |
| | Middle | 180 | 110 | 70 | 230 | 110 | 120 | 290 | 110 | 180 |
| | Upper | 420 | 250 | 170 | 560 | 250 | 310 | 700 | 250 | 450 |
| | Total | 900 | 540 | 360 | 1,200 | 540 | 660 | 1,500 | 540 | 960 |

1905

6468

455

6013

1455

## Resident Fish

The projected demand for resident trout exceeds the quantity expected to be supplied (Table III-6). Even at present, wild populations of trout cannot supply the existing demand. Extensive releases of hatchery trout are needed to augment the natural supply. Natural production of warm-water game fish is expected to keep pace with future demand, but available supplies will not, without accelerated fisherman-access programs.

## FUTURE PROBLEMS

Problems of the future will be, to a large extent, the same as problems of the past and present. Probably the most serious problem for the fisheries will be a continued increase in the amount of water diverted from Willamette Basin streams, lakes, and reservoirs. Although many diversions will be nonconsumptive (because the water will return to the stream), the water cannot be used for fish from the point of diversion to the point of return. Such a loss of use is especially serious to anadromous fish because of their needs for large water quantity and high water quality when spawning, rearing, and migrating.

Diversions of water also result in increased water temperatures. The water volume in the stream is reduced and water velocity drops. The result is that the smaller volume is heated by solar radiation at a faster rate than would a larger volume. Increased stream water temperatures also occur because of return flows from diversions. These flows often pick up heat from such things as sewage treatment plants, thermal electric plants, and prolonged exposure to sunlight. Thermonuclear power plants planned for Willamette Basin are among the most serious temperature pollutant threats envisioned for the future. These, however, may not materialize. Under present State policies operating controls are required by the Sanitary Authority and other regulatory agencies before permits will be issued.

Sometimes water temperatures are increased because of new reservoirs on the stream. This increase is common when the reservoirs are small and shallow and when the outlet of the reservoir takes mostly surface water. Conversely, when reservoirs are large and deep and the outlet takes water near the bottom, water temperatures downstream may be decreased.

Dams and reservoirs generally reduce the success of anadromous fish migrations, even when fish-passage facilities are present. Juvenile anadromous fish often remain in reservoirs and fail to complete their life cycle by not migrating to the sea. Adult anadromous fish often suffer losses from delays in finding their way upstream over the dams. Continued research on these problems in fish passage will be necessary if solutions are to be found.

Major problems resulting from pollution and gravel-mining operations are expected to be under control by 1980, but constant vigilance will be required to maintain control. Familiar types of pollution will continue to be a potential source of problems, but other types should also be expected to appear, such as thermal pollution from nuclear reactors. Solutions to these problems must be developed as they occur since many times they cannot be anticipated.

The destruction of fish and fish habitat by severe floods is an ever-present problem. Floodwaters scour streambeds, destroying eggs and fry in the gravel. Severe flooding may create new channels thus eliminating valuable spawning beds in previously existing channels.

Piledriven shear booms and revetted dikes constructed to hold the streams within the present channels tend to increase stream velocities to the point that spawning gravels are washed to lower river areas. Gravel in lower areas is less valuable for fish production than that in the headwaters.

Much of the main river and major tributaries are lined with dense, low thickets and taller deciduous trees. Removal of these groves would expose the stream to direct sunlight and could warm the waters to temperatures higher than the tolerable limit for anadromous or resident gamefish production.

Intensive use of pesticides and herbicides on croplands and forest lands adjacent to Willamette Basin watercourses is expected to present increasingly difficult problems to fish conservation agencies in the future. Even introductions of these toxic chemicals into fish-producing waters in minor amounts can destroy large numbers of fish in a short time, or reduce overall production even though actual fish kills do not occur.

Some logging practices result in damaged or destroyed fish and fish habitat. Examples of damages are siltation, increase in water temperature, and formation of debris jams that block fish migration. Logging practices are being improved through the efforts of conservation-conscious logging companies and forestry agencies. However, poor logging practices by indifferent or irresponsible loggers will cause fishery problems.

Increased public access and facilities for future Willamette Basin human populations will be necessary to furnish more area for different forms of recreation. Even though public access and facilities will increase, more and more private land will be posted against trespassing.

The foregoing problems have presented a pessimistic forecast for future fish resources of Willamette Basin. However, there are strong indications that individual and group actions will tend to voluntarily control activities that would harm the basin's fish populations. For problems that cannot be thus solved, an informed public may demand appropriate legislation to protect these valuable resources.

# WILDLIFE

## GOALS

The general goal of wildlife management is to provide maximum harvestable numbers of animals and birds consistent with the desires of residents and the economic development of the basin. Specific objectives consistent with that goal are to maintain dynamic ecological balances and preserve all desirable native wildlife forms.

## GENERAL

This portion of the Fish and Wildlife Appendix is primarily an analysis of the probable direction of trends in use in terms of numbers of hunters, harvest, and recreation days. These projections are based on the assumption that trends will continue in the future as in the recent past, except that there will be more efficient management of game species. These use trends are summarized in Table III-7.

Demand is analyzed with the additional assumptions that the number of hunters from Willamette Basin that leave the basin to hunt species that reside within the basin is a measure of present unsatisfied demand for hunting in the basin. Demands are summarized in Table III-8.

The difference between use (Table III-7) and demand (Table III-8) is a measure of the need for increasing the numbers of wildlife, and the opportunity to hunt. For some species, i.e. rabbits, future demand has been calculated as being less than is indicated as future use because they are alternative prey species for which most demand exists only if more desirable quarry is unavailable. For most species, however, demand is calculated to be much greater than supply, particularly in the later years of the study period.

For most forest-dwelling species--black-tailed deer, elk, and grouse--supply can be more nearly equated to demand than for other species because much of the habitat is on public land little subject to changes in land use, and funds may be supplied for habitat improvement as a public good. For most waterfowl and valley-dwelling species most of the habitat is on private land and changes in land use will destroy breeding and feeding habitat and will result in declining populations and hunting opportunities.

Increased game management efficiency will allow harvesting a greater percentage of most wildlife populations. When wildlife managers become more proficient in measuring wildlife numbers and controlling hunting pressure, a larger percentage of the pre-season population can be harvested without hurting the population's reproductive capacity. Table III-9 gives estimated maximum harvest potentials for the major wildlife species in the basin.

Table III-7
*Projected hunter use and game harvest in Willamette Basin, for the years 1980, 2000 and 2020*

| | 1980 | 2000 | 2020 |
|---|---|---|---|
| | Number (x 1,000) | | |
| Human population | 1,768 | 2,422 | 3,591 |
| Hunting license holders | 350 | 500 | 640 |
| No. of hunters using basin | 200 | 280 | 340 |
| BIG GAME | | | |
| Deer: | | | |
| Hunters | 90.0 | 120.0 | 140.0 |
| Harvest | 50.0 | 53.0 | 57.0 |
| Hunter-days | 410.0 | 600.0 | 650.0 |
| Elk: | | | |
| Hunters | 3.3 | 6.6 | 12.0 |
| Harvest | 0.5 | 1.0 | 1.2 |
| Hunter-days | 10.0 | 20.0 | 30.0 |
| Bear: | | | |
| Hunters | 2.2 | 2.8 | 4.0 |
| Harvest 1/ | 1.3 | 1.8 | 2.5 |
| Hunter-days | 6.0 | 9.0 | 12.0 |
| Cougar: | | | |
| Hunters | 0.8 | 0.0 | 0.0 |
| Harvest 1/ | 0.01 | 0.0 | 0.0 |
| Hunter-days | 3.0 | 0.0 | 0.0 |
| SMALL GAME MAMMALS | | | |
| Gray Squirrel: | | | |
| Hunters | 1.5 | 2.0 | 3.0 |
| Harvest | 5.8 | 6.2 | 7.0 |
| Hunter-days | 7.0 | 8.0 | 10.0 |
| Rabbits: | | | |
| Hunters | 4.0 | 7.0 | 12.0 |
| Harvest | 48.0 | 90.0 | 150.0 |
| Hunter-days | 24.0 | 50.0 | 100.0 |

Table III-7 (Cont'd)

| | 1980 | 2000 | 2020 |
|---|---|---|---|
| | Number (x 1,000) | | |
| MISCELLANEOUS MAMMALS 2/ | | | |
| Hunters | 25.0 | 40.0 | 50.0 |
| Harvest | 96.0 | 154.0 | 192.0 |
| Hunter-days | 110.0 | 180.0 | 230.0 |
| UPLAND BIRDS | | | |
| Mourning Dove: | | | |
| Hunters | 15.0 | 50.0 | 75.0 |
| Harvest | 155.0 | 135.0 | 135.0 |
| Hunter-days | 62.0 | 88.0 | 112.0 |
| Band-tailed Pigeon: | | | |
| Hunters | 12.0 | 18.0 | 20.0 |
| Harvest | 60.0 | 62.0 | 60.0 |
| Hunter-days | 35.0 | 40.0 | 50.0 |
| Pheasant: | | | |
| Hunters | 40.0 | 80.0 | 100.0 |
| Harvest | 75.0 | 110.0 | 130.0 |
| Hunter-days | 170.0 | 270.0 | 340.0 |
| Quail: | | | |
| Hunters | 30.0 | 50.0 | 55.0 |
| Harvest | 70.0 | 85.0 | 85.0 |
| Hunter-days | 75.0 | 115.0 | 140.0 |
| Grouse: | | | |
| Hunters | 11.2 | 16.0 | 20.0 |
| Harvest | 26.2 | 30.0 | 30.0 |
| Hunter-days | 29.0 | 33.0 | 33.0 |
| WATERFOWL | | | |
| Hunters | 20.0 | 27.0 | 42.0 |
| Harvest | 80.0 | 75.0 | 60.0 |
| Hunter-days | 138.0 | 157.0 | 200.0 |
| TOTAL HUNTER-DAYS | 1,079.0 | 1,570.0 | 1,907.0 |

1/ *Includes population control kill.*
2/ *Includes bobcat, coyote, fox, nutria, raccoon, and opossum.*

Table III-8

*Projected demand for wildlife in Willamette Basin for the years 1980, 2000, and 2020*

| | 1980 | 2000 | 2020 |
|---|---|---|---|
| | Number (x 1000) | | |
| BIG GAME | | | |
| Deer: | | | |
| Hunters | 215 | 307 | 392 |
| Harvest | 96 | 137 | 175 |
| Hunter-days | 1,032 | 1,475 | 1,880 |
| Elk: | | | |
| Hunters | 5.4 | 7.7 | 9.8 |
| Harvest | 0.8 | 1.2 | 1.4 |
| Hunter-days | 31.0 | 44.0 | 56.0 |
| Bear: | | | |
| Hunters | 5.8 | 8.3 | 10.6 |
| Harvest | 2.2 | 3.1 | 4.0 |
| Hunter-days | 17.5 | 25.0 | 32.0 |
| Cougar: | | | |
| Hunters | 1.0 | 1.4 | 1.8 |
| Harvest | 0.03 | 0.04 | 0.06 |
| Hunter-days | 5.2 | 7.4 | 9.5 |
| SMALL GAME MAMMALS | | | |
| Grey Squirrel: | | | |
| Hunters | 2.1 | 3 | 3.8 |
| Harvest | 9.4 | 13.4 | 17.1 |
| Hunter-days | 11.0 | 15.7 | 20.0 |
| Rabbits: | | | |
| Hunters | 5.2 | 7.4 | 9.4 |
| Harvest | 47.0 | 67.0 | 86.0 |
| Hunter-days | 26.0 | 37.0 | 47.0 |
| MISCELLANEOUS MAMMALS | | | |
| Hunters | 42.0 | 60.0 | 77.0 |
| Harvest | 162.0 | 231.0 | 295.0 |
| Hunter-days | 157.0 | 224.0 | 286.0 |

Table III-8 (Cont'd)

| | 1980 | 2000 | 2020 |
|---|---|---|---|
| UPLAND BIRDS | | | |
| Dove: | | | |
| Hunters | 18.7 | 26.7 | 34 |
| Harvest | 232.2 | 331.0 | 423 |
| Hunter-days | 87.0 | 124.0 | 158 |
| Pigeon: | | | |
| Hunters | 17.1 | 24.4 | 31.2 |
| Harvest | 119.0 | 170.0 | 217.0 |
| Hunter-days | 70.0 | 100.0 | 128.0 |
| Pheasant: | | | |
| Hunters | 120.0 | 171.0 | 218.0 |
| Harvest | 332.0 | 474.0 | 606.0 |
| Hunter-days | 532.0 | 760.0 | 973.0 |
| Quail: | | | |
| Hunters | 34.6 | 49.4 | 63.2 |
| Harvest | 183.0 | 261.0 | 340.0 |
| Hunter-days | 160.0 | 229.0 | 294.0 |
| Grouse: | | | |
| Hunters | 11.2 | 20 | 34 |
| Harvest | 26.2 | 37.4 | 47.8 |
| Hunter-days | 29.0 | 41.0 | 52.0 |
| WATERFOWL | | | |
| Hunters | 35.0 | 50.0 | 64.0 |
| Harvest | 218.0 | 311.0 | 398.0 |
| Hunter-days | 329.0 | 471.0 | 603.0 |
| TOTAL HUNTER DAYS | 2,486.0 | 3,553.1 | 4,538.5 |

Table III-9
*Estimated maximum harvest1/ of pre-season wildlife populations*

| Species | Harvest (percent) |
|---|---|
| Big Game: | |
| deer | 35 |
| elk | 20 |
| bear | unknown |
| cougar | unknown |
| Small Game: | |
| gray squirrel | unknown |
| mourning dove | 50 |
| band-tailed pigeon | 30 |
| pheasant | 65 |
| quail | 65 |
| grouse | 65 |
| Waterfowl: | |
| ducks | 60 |
| geese | 50 |

1/ *Estimated maximum harvest is defined as that portion of the total species population that could be harvested each year without depleting the breeding population to such a degree that a like number of animals would not be available for harvesting during each succeeding year, under average conditions.*

## HUNTING PRESSURE

The human population of Willamette Basin in 1965 was more than 1.3 million. Projections of the Economic Base Study indicate an increase to about 1.8 million by 1980, 2.4 million by 2000, and 3.6 million by 2020. It was estimated that there were 200,000 licensed hunters in Willamette Basin in 1965. This was projected to 350,000 by the year 1980, to 500,000 by the year 2000, and to 640,000 by the year 2020. However, because of limited hunting opportunities in Willamette Basin compared with the state as a whole, a significant number of the license holders residing in Willamette Basin will not actually hunt there. The number of hunters using the basin in 1965 was estimated at 120,000, about 60 percent of the basin's licensed hunters. The percent of hunters using the basin will gradually decline, while the total number of licensed hunters in the basin will increase. See Table III-7.

The fact that there were 200,000 hunters licensed in Willamette Basin in 1965 indicates that there was a demand for at least the amount of hunting opportunity required to satisfy 200,000 hunters rather than

enough to satisfy the 120,000 that actually hunted in the basin. Since each hunter that hunted in the basin in 1965 spent 7.12 days at this sport, the demand must then have been for at least 1,424,000 days of hunting opportunity. A projection of this minimum demand, at the target date, expressed in hunter days is indicated in Table III-8 for each important species or group of species hunted in Willamette Basin.

## EFFECTS OF WATER DEVELOPMENT PROJECTS

Water development projects will have mixed effects on wildlife in the basin. Their impact, to a large degree, will depend on specific provisions that are made for habitat enhancement. Some wildlife species will be benefited while others will be adversely affected. The following summary gives a breakdown of the various effects that water development projects have on species.

1. Species that would probably benefit from any water development project that would not involve drastic changes in stream discharge: otter, mink and ducks.

2. Species that would probably benefit from any water development project that makes specific provisions for habitat enhancement--such as reservoir level stabilization, stream discharge stabilization, pollution abatement, and stream bank development: raccoon, nutria, muskrat, beaver, geese, and swans.

3. Species that would probably benefit only from water development projects involving irrigation of agricultural land and where specific provisions are included for wildlife habitat enhancement: fox, coyote, gray squirrel, rabbit, opossum, mourning dove, pheasant, and quail.

4. Species that would probably be unaffected by any water development project: bobcat, marten, and bear.

5. Species that would probably be adversely affected by most water development projects: deer, elk, cougar, fisher, band-tailed pigeon, and grouse.

## HUNTING SITUATION

Hunting activity by the turn of the century will vary primarily with respect to the species being hunted. For some species most resident hunters will travel out of the basin while for other species many hunters with residence outside the basin will hunt in Willamette Basin. The probable hunting situation for the year 2000 by wildlife species is shown in the following summary:

1. Species more available in adjacent basins where hunter saturation is not anticipated. Most hunters resident in Willamette Basin will travel outside the basin and very few outside residents will travel into the basin: bobcat, cougar, coyote, and chukar partridge.

2. Species more available in adjacent basins where hunter saturation is anticipated. Fewer hunters resident in Willamette Basin will travel outside the basin to hunt these species as open land becomes progressively more saturated with hunters, forcing many hunters to use less popular lands within the basin: deer, elk, and turkey.

3. Species equally available within Willamette Basin and in adjacent basins. Most resident hunters will hunt in the basin and few residents of adjacent basins will enter Willamette Basin to hunt these species: raccoon, bear, rabbit, mourning dove, band-tailed pigeon, quail, and grouse.

4. Species more available within Willamette Basin than in adjacent basins. Most residents will hunt within the basin and many outside residents will travel to the Willamette Basin to hunt: fox, nutria, gray squirrel, opossum, pheasant, ducks, and geese.

## WILDLIFE PROJECTIONS

### Big Game Mammals

Important big game species in Willamette Basin include deer, elk and bear. Cougar are few in number and unless protection is continued will be extinct by year 2000. Projections of hunters, harvest, and hunter-days for these species by time periods are shown in Table III-7.

Future development of Willamette Basin land and water resources will have mixed effects on big game population and harvest. Anticipated forest management procedures will generally benefit wildlife resources and their utilization. Carefully planned clear-cutting operations can do much to maintain populations at a consistently high level in a given herd range area by providing a continued, rotating supply of browse in young forest regrowth tracts. Increased harvest of forest resources will also open up previously inaccessible areas to hunters, allowing a more efficient harvest.

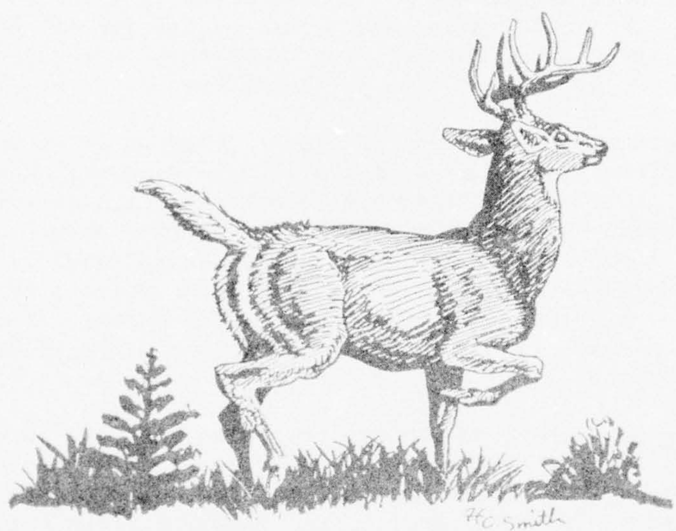
As the willingness of people to pay for recreation increases, the large private land holdings with restricted access to big game hunters will be opened, probably on a fee basis. It is also anticipated that an increase will occur in the popularity of "trophy hunting"--in which the hunter is characteristically willing to spend more recreation days with a relatively low chance of success.

The number of residents traveling out of Willamette Basin to hunt deer and elk in other parts of the State will increase rapidly for the next several years. However, sometime before the turn of the century most of the better big game hunting areas of Oregon will become saturated with hunters, forcing many hunters to use less productive or less popular areas such as Willamette Basin. Nonresident hunters will not become an important factor in Willamette Basin.

As agriculture becomes more intensified in the valley and foothill areas, more conflict between deer, elk, and bear and agricultural crops will occur. Increased hunting pressure and possible development of new damage control techniques may alleviate this problem.

Water resource development generally has an adverse effect on big game populations, e.g., when reservoirs inundate winter range used by deer and elk.

Improved survey and harvest control techniques will allow a more efficent harvest of the annual deer and elk population surpluses (Table III-9). However, because of the brushy and rugged characteristics of much of the habitat areas it may be difficult to achieve a highly efficient harvest.



Deer

In recent years, deer hunters have made up nearly 95 percent of the big game hunters and deer represent most of the big game harvest in the basin. By the year 2020, deer hunters will represent about 90 percent of big game hunters and will harvest about 93 percent of big game species.

During the period 1961-65, an estimated 65,000 hunters spent about 310,000 hunter-days to harvest some 29,000 deer annually for a hunter success of about 45 percent. It is anticipated that the number of hunters will more than double by the year 2020, matched by a corresponding increase in hunter-days. Because of limitations of available habitat, the deer population will not be able to supply this increased demand. Therefore, the harvest is projected to reach only 57,000 by 2020 for a hunter success of about 40 percent.

Elk

Elk are not numerous in Willamette Basin, but possess a potential for increase. In recent years, about 1,400 elk hunters spent some 8,000 hunter-days to harvest about 200 elk annually for a hunter success of only about 15 percent. By 2020 the number of hunters will increase nearly nine-fold to harvest a crop of about 1,200 elk, a 10 percent hunter success. The increased harvest will be due primarily to improved survey and harvest control techniques which will allow a more efficient harvest of the annual population.

## Bear

Most bear hunting is, and will continue to be, incidental to deer and elk hunting. The maximum harvest that may be obtained without reducing the base population is unknown, but bear can undoubtedly withstand much more hunting pressure than they are now receiving. During the 1961-65 period, about 2,000 hunters spent 6,000 hunter-days to harvest about 800 animals annually, for a 40 percent success. By 2020 the number of hunters will have doubled to 4,000, the number of hunter-days will have doubled to 12,000, and the harvest will have tripled to about 2,500 animals, for an increased hunter success of about 60 percent. This is based on the assumptions that the bear habitat will be increased through logging, hunter access will be improved, and the popularity of trophy hunting will increase.

## Cougar

Cougar have recently been placed under the protection of State law. This may halt the recent more-or-less steady decline of this species in Willamette Basin, but the population may never again reach huntable numbers unless large tracts of undisturbed primitive habitat can be preserved.

## Small Game Mammals

About 5,400 gray squirrels are harvested annually by 1,200 hunters in 6,400 hunter-days for a harvest success of about 4.5 animals per hunter. No reliable information is available on which to base estimates of rabbit hunting. However, it is believed that about 3,000 hunters spend some 15,000 hunter-days to harvest about 27,000 animals annually for a hunter success of about nine animals per hunter. By 2020 hunting for both species is expected to increase more than 4-fold to 15,000 hunters. Over 110,000 hunter-days will be spent to harvest nearly 160,000 animals for a hunter success of more than 10 animals per hunter. These increases are based on the premise that decreasing hunter opportunities for big game and other small game species will cause a shift in hunter emphasis to these now lightly utilized forms. However, more intensified agriculture and increased urbanization will tend to limit the population and harvest of these small game species.

*Photo III-2. Nutria afford a small measure of hunting. (Bureau of Sport Fisheries and Wildlife photo)*

## Miscellaneous Mammals

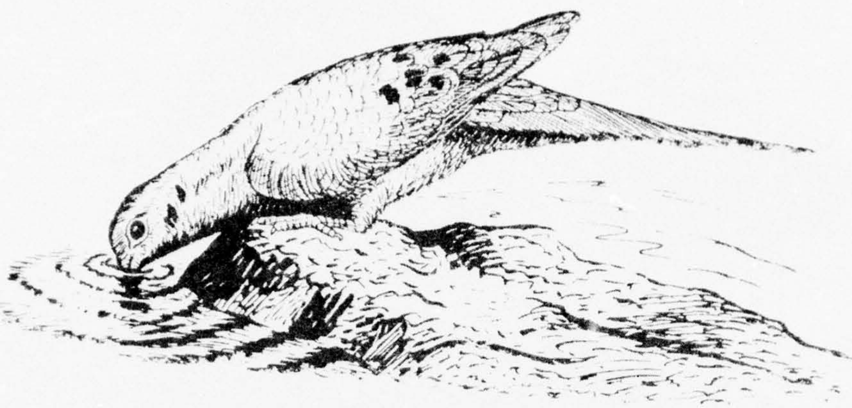
Mammals such as bobcat, coyote, fox, nutria, raccoon, and opossum, presently afford a small measure of hunting. It is estimated that about 20,000 hunters spend some 78,000 hunter-days in this type of hunting. Because of the increasing hunter demand and the decreasing opportunity to fulfill this demand, it is anticipated that more hunting effort will shift to these species so that by the year 2020 about 50,000 hunters--a 2-1/2 fold increase--will spend 230,000 hunter-days exploiting this recreation potential.

These species are also trapped. In recent years, about 250 trapping licenses have been issued annually. This is a large reduction from the period immediately following World War II. An even greater decline in trapping pressure and economic value of furs harvested has occurred. Neither value nor trapping pressure is expected to change markedly in the future.

Reduction in the amount of trapping, the introduction of exotic species, and other factors have resulted in at least local increases of some species. Certain of these will require spot control in the future to reduce damage to property, control disease, and to protect poultry, livestock, and more valuable species of wildlife.

## Upland Birds

Mourning doves, band-tailed pigeons, pheasants, quail, and grouse are the five important species of upland birds. Table III-7 shows the projected number of hunters, harvest, and hunter-days for these species for 1980, 2000, and 2020.



### Mourning Doves and Band-tailed Pigeons

About 15,000 hunters spend nearly 62,000 hunter-days to harvest some 149,000 pigeons and doves for a hunter success of nearly 10 birds per hunter annually. By the year 2020 it is estimated that the number of hunters will have increased 6-fold to 95,000, and they will be spending some 162,000 hunter-days to harvest about 195,000 pigeons and doves for less than a 2-bird yield per hunter-day. Harvest of these species will reach a maximum of about 215,000 by 1980, and gradually decline thereafter. Assuming a continuation of current agricultural practices, the mourning dove population will probably remain fairly static. Band-tailed pigeon populations will probably decline slightly as lowland and foothill nesting areas are depleted by intensive urban, agricultural, and industrial development.

The maximum allowable portion of the population of band-tailed pigeons is probably harvested now. Many more mourning doves could probably be harvested without affecting reproductive potential (Table III-9). Therefore, mourning doves will likely bear the brunt of increased hunter demand.

Agriculture can have varying effects on dove and pigeon populations, depending on the types of crops and intensity of land use. Water development projects would have adverse effects if the lowland habitat areas and "pigeon springs" were inundated. Pigeon springs are mineral springs heavily used by band-tailed pigeons, and are apparently necessary to their health. Irrigation developments would tend to increase dove and pigeon populations, but would depend to some degree on the type of crops raised and the type of land development associated with ditches, waste-ways and reservoirs in the project area.

Under present methodology, there appears to be little potential for artificial propagation or shooting preserve-type exploitation of these species. However, some future development or setting aside of pigeon springs may be feasible.

Pheasant and Quail

In recent years more than 50,000 hunters spent nearly 240,000 hunter-days to harvest about 64,000 quail and 115,000 pheasants in the basin annually. If present trends continue and no effort is made to develop the pheasant and quail populations and hunting potential, the number of hunters by year 2020 will have tripled and the number of hunter-days will have increased 2-1/2 times, but the harvest will have increased only about 20 percent to about 85,000 quail and 130,000 pheasants. These projections are based on the premise that increased management efficiency and better hunting pressure control will permit an orderly and efficient harvest (Table III-7), and that increased urbanization, industrialization and agricultural development of Willamette Valley will reduce game bird habitat.

Grouse

Grouse hunting fluctuates drastically depending upon the abundance of these highly cyclic species. In recent years more than 6,000 hunters spent nearly 17,000 hunter-days to harvest about 15,000 grouse annually. This is less than the harvest that could be realized, so increases to 20,000 hunters and 33,000 hunter-days by the year 2020 would probably result in a 2-fold harvest increase to about 30,000 birds. This is primarily based on the assumption that more hunters will harvest these species as opportunities for hunting other species decline and access to grouse habitat areas is improved.

Present and anticipated forestry management practices benefit ruffed and blue grouse. Water development projects which flood the more productive lowland and streamside habitat would generally have minor adverse effects on grouse. Where urban and industrial development occurs on flood plain margins along Willamette River and its major tributaries, ruffed grouse habitat would be virtually eliminated.

## Waterfowl

In recent years some 14,000 waterfowl hunters have spent about 113,000 hunter-days annually to harvest approximately 85,000 ducks and geese. The popularity of this sport is expected to increase so that by the year 2020 there will be about 42,000 hunters. Because of season restrictions and limited hunting opportunity hunter-days will not increase correspondingly; only about 200,000 hunter-days will be expended annually by 2020. If the present trend continues, waterfowl numbers will drop drastically resulting in a harvest decline to about 60,000 birds in 2020--nearly a 20 percent loss. These projections were based on the assumption that lost breeding habitat and steady water and land development encroachment on resting and wintering grounds in the Pacific Flyway will decrease waterfowl populations and reduce hunting opportunities.

Some of the anticipated land and water development within the basin would be detrimental to waterfowl unless special precautions are taken. For example, fluctuating reservoirs have little value to waterfowl except for resting. Reservoir stabilization during critical nesting periods, the development of small reservoirs, and marshland preservation and development would all directly benefit duck and geese populations.

Improvements in management techniques would allow better control of hunting pressure and improve efficiency of harvest. There is also a potential for some harvest of the presently unexploited swan population.

## Furbearers

Furbearer harvest was not projected for this study. Undoubtedly continued destruction of habitat will lead to marked decreases in numbers of several species in the future. However, most of these animals can be raised artificially in "fur farms", so whenever pelt prices justify artificial propagation this need will be supplied by private industry.

## Miscellaneous Birds

Several species of exotic birds may provide future hunting opportunities in Willamette Basin. The Oregon State Game Commission is investigating several exotics with this idea in mind. The success of introducing turkey into central Oregon may presage similar successes within Willamette Basin.

Birds of several species may become so numerous locally that they damage crops, destroy property, and are a general nuisance. Control may become necessary if damages outweigh benefits. Research in control methods for these problem species is underway.

Bird study, nature hiking, wildlife photography, and similar activities are expected to increase rapidly in the future. However, present and future demand for this use have not been estimated. It is very possible these activities may increase at the same rate as other general outdoor recreation activities, as presented in Appendix K.

## FUTURE PROBLEMS

The major problem affecting wildlife populations of Willamette Basin is the almost universal one of steadily declining quality and quantity of habitat coupled with a steadily increasing demand. Use of land for homes, highways, airports, industry and more intensified agriculture is reducing the amount of habitat available to most forms of wildlife and will continue to do so at an accelerated rate.

A decline in quality of habitat is associated with the decline in quantity. Everything man does to modify his environment affects the environment of other living things. Wildlife suffer from intensive land use, water and air pollution, disturbance by people, and other factors associated with a rapidly increasing human population.

As population grows, the economic values of wildlife become more apparent, and the tendency of landowners to allow access only on a special privilege or fee basis becomes more pronounced. This increases the demands on the remaining supply and accelerates the decline of free public hunting.

Single purpose use of resources is becoming more of an issue than it has been in the past. When Willamette Basin had a relatively low human population, closure of large areas to public use had little effect on total hunter use of the basin. In the future, when hunting space commands a higher premium, the large municipal watersheds will require justification, both economic and political, for their continued existence as sacrosanct areas. Other large areas of public lands in Willamette Basin are closed to public access because of the "checkerboard" pattern of land ownership which permits private landowners to block public access to public lands.

Depredation by wildlife is a present problem that in some cases will be accentuated in the future. Many species of wildlife cause economic losses or are nuisance animals. Deer, elk, rabbits, porcupines, squirrels, and bears damage or destroy trees; mammal and bird predators kill livestock and poultry; and rodents and birds damage or destroy field and orchard crops.

Future wildlife problems will result from the construction of water development projects. Many oxbow lakes and channel sloughs along Willamette River obtain the bulk of their water from spring floods. Flood control reservoirs and channel excavation will lower flood crests and eliminate excellent wildlife habitat that results from normal flooding. Channel excavation, construction of flood control dikes and reservoirs, and other flood control installations destroy riparian wildlife habitat. Large lined canals used to transport water from reservoirs to irrigate valley lands will pose problems to wildlife, particularly to big game, if they intersect accustomed lines of travel. Big game losses by drowning and physical injury or death by abrasion frequently result from lined canals if no provisions are made to protect them.

Financing is one of the basic problems that confronts wildlife managers in their attempts to supply sufficient hunting opportunity to satisfy demands. The State Game Commission is financed by receipts from hunting licenses and permit sales, and by transfer funds derived from the Federal tax on sporting arms and ammunition. Although receipts from these sources have increased in the recent past, the increases have not been sufficient to keep pace with spiralling costs. Many worthwhile programs--Federal as well as State--have been held in abeyance in the hope that financial conditions will improve. Among the most pressing needs are basic research involving habitat manipulation, harvest control, hunter distribution, and motivation. Also needed are studies involved in determining more efficient methods of wildlife habitat development and resource enhancement.

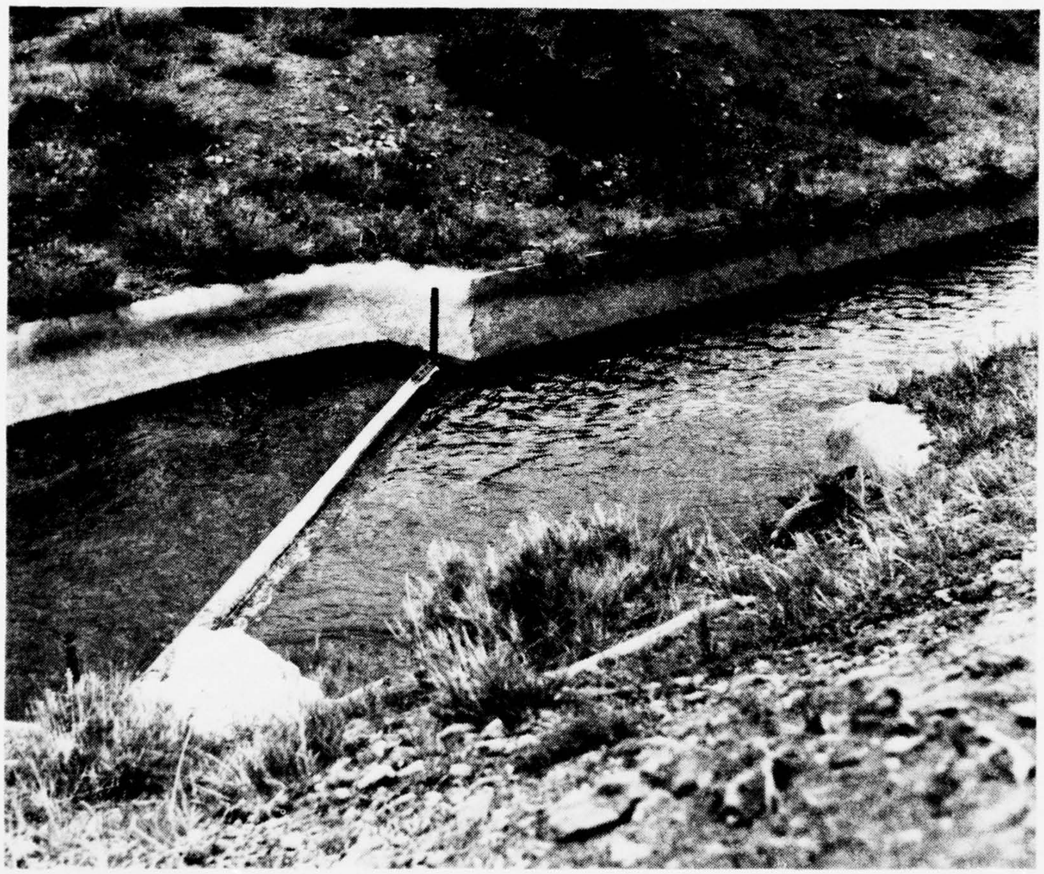


*Photo III-3. Deer escapement device in lined canal. The doe, right, is recovering after escaping. (Bureau of Sport Fisheries and Wildlife photo)*

# PART IV

# ALTERNATIVE MEANS TO SATISFY DEMANDS

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Lowland Lakes

# FISH

## GENERAL

This portion of Part IV presents alternative methods to help satisfy the projected demands for fish indicated in Part III. Some of these alternatives are associated with multiple-purpose projects, whereas others relate only to fish. However, enough alternatives are presented to provide several approaches for satisfying sport and commercial fishery demands during the projection periods. Table IV-1 shows the anadromous fish escapement and new opportunities for resident fish angler-use needed to fulfill future fisheries demands.

Table IV-1
*Additional fishery needs, 1980-2020*

| Fish | 1980 | 2000 | 2020 |
|---|---|---|---|
| | | (thousands of fish) | |
| Anadromous | | | |
| Spring chinook | 122 | 218 | 436 |
| Fall chinook | 217 | 72 | 507 |
| Coho | 143 | 256 | 532 |
| Winter steelhead | 10 | 13 | 52 |
| Summer steelhead | 178 | 197 | 364 |
| Resident | | (thousands of angler-days) | |
| Trout | 360 | 760 | 1,440 |
| Warm-water | 120 | 220 | 320 |

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Each alternative method for supplying anadromous fish through improved or increased habitat is evaluated in terms of increased spawning escapement. Table IV-2 gives a general indication of the benefit of increased escapement in terms of sport and commercial fishery value.

Table IV-2
*Utilization based upon fish escapement*

| Species | Sport and Commercial Value/Fish Escaping to Spawn 1/ | |
|---|---|---|
| | Angler Days 2/ | Pounds Harvested 3/ |
| Spring chinook salmon | 10.7 | 45.3 |
| Fall chinook salmon | 7.5 | 76.5 |
| Coho salmon | 0.6 | 16.8 |
| Winter steelhead trout | 1.3 | 0.8 |
| Summer steelhead trout | 10.7 | 6.0 |

1/ *To the limit of available spawning and rearing area.*
2/ *Present value of an angler-day is $6.*
3/ *Based on the following market prices, which often change, the average values per pound are $0.56 for fall and spring chinook, $0.39 for coho, and $0.30 for summer and winter steelhead.*

Thus, as an example, the progeny of each spring chinook escaping to spawn will, on the average, supply 10.7 days of sport fishing to the sportsmen, and 45.3 pounds of fish to the commercial fishermen.

Alternative methods for supplying resident fish are evaluated in terms of increased angler use. Such use is currently valued at $2 per angler-day for trout angling in a lake or reservoir, $3 per angler-day for trout stream fishing, and $1.50 per angler-day for warm-water fishing.

Changes in these values, or in market prices for anadromous fish, catch-to-escapement ratios, sport-to-commercial-catch ratios, or other factors affecting values of fish, will be reflected in the evaluation of individual projects by the fisheries agencies.

## IMPROVED STREAMFLOWS

This section presents the possible fishery benefits which could result from construction of appropriately planned and operated new water resource development projects or modifications of existing projects. Conversely, these data can also be used to estimate mitigation if this is required. The downstream effect of these projects depends upon both water quantity and water quality. In some streams, impoundment could result in turbid waters downstream which would hinder fishing and reduce fish production. Such conditions often exist downstream from Hills Creek Reservoir on Middle Fork Willamette River, and have occurred below Cougar Reservoir on South Fork McKenzie River.

Water resource development projects that reduce minimum flows or inundate fish spawning beds, will result in fishery losses. Such losses will require mitigation at project expense.

Water development projects provide opportunity to augment downstream flows by releasing water from storage. Higher flows will affect angling on some streams. For example, increased flows could force anglers from the streambed into dense brush, which would hinder casting and hiking. In deeper streams increased flows might reduce wading opportunities, but these flows might also furnish enough water to make angling from boats feasible. Without extensive field studies, there is no way to evaluate the effect of additional water on angling from boats. One study showed that there is a low-flow limit where boat angling becomes possible, but that there is also an upper limit where boating becomes dangerous.

### Flows and their Effects on Anadromous Fish

Existing flows and the present anadromous fish escapement potentials are tabulated in the Addendum for stream reaches that may be affected by water storage projects. These flows must be provided to maintain the resource supply shown in Part III - Future Demand. Possible enhancement to anadromous fish runs from optimum streamflows is also shown in the Addendum.

In calculating escapements under optimum flow conditions, it was assumed that water quality will be adequate. If it is not adequate, larger flows may be needed to meet quality standards. In salmon and trout streams, adequate water quality should include water temperatures of about 55° F during upstream migrations of adults, 45° F during holding periods of the adults, and 50° F from egg deposition to fry emergence. Temperatures up to 60° F could be tolerated after fry emergence for rearing juveniles provided adult fish are not present. In addition, dissolved oxygen should be above 7 parts per million, and other water quality standards relating to dissolved nitrogen, pH, turbidity, noxious chemicals, pollutants, etc., must be met.

### Flows and their Effects on Resident Fish

Generally, the minimum flows and water quality needed for anadromous fish are also necessary to maintain the resident fish populations and the fishery. Optimum flows will have a beneficial effect on resident fish populations, but the benefits have not been determined and must be evaluated as water-development projects are proposed. The effect will vary according to the specific stream.

## HABITAT IMPROVEMENT PROJECTS

This section describes habitat improvement projects for fish enhancements. These projects include: providing fish passage, improving water quality, eradicating or controlling nongame fish, improving stream habitat, and constructing impoundments. Developments planned for improving fisheries must meet certain specific requirements to be successful. These requirements are reflected in the project cost estimates.

## Anadromous Fish

### Fish Passage at Waterfalls and Cascades

Waterfalls and cascades block runs of anadromous fish in the upper reaches of many streams. To achieve fish passage, some barriers can be altered by blasting, but others will require construction of fish ladders. The benefits (potential escapement), costs, and methods of providing fish passage are shown in Table IV-3.

In cases where blasting or constructing a fish ladder is not feasible, fish can be trapped and hauled to a release point upstream from the barriers. In some years, however, excess hatchery fish can be used as an alternative to trapping. This method is being used at the present time as part of the program to increase anadromous fish production in Willamette Basin. Benefits from the continuance of this program will be similar to those listed in Tables IV-3 and IV-4, but would be somewhat less because of larger supply and distribution costs.

### Fish Passage at Existing Dams and at Barriers Upstream

Table IV-4 lists dams that block spawning runs of anadromous fish in Willamette Basin, as well as costs and benefits of providing fish passage. Adult anadromous fish need upstream fish passage, and juvenile anadromous fish need downstream passage. In most cases, upstream fish passage will require fish traps at the base of the dam and trucks to haul the fish above the dam. Downstream fish passage will require a facility to remove downstream migrants from the stream so that they can be transported around the reservoir.

Fish passage at some of the dams listed cannot be assured at the present level of technology, but there is reason to believe that the problems of fish passage at high dams will be solved in the future.

### Impoundment Rearing

With artificial feeding, small reservoirs show promise for rearing anadromous fish to migratory size (from fry to smolt stage). Impoundment rearing, however, is still in the experimental stages. Even though the size of the smolt emigrations indicates success, additional time is necessary to allow for adult returns and to evaluate the production techniques.

Table IV-5 shows the locations of some impoundment sites, their costs for development and annual operation and maintenance, estimated production (out-migration) of smolts, and anticipated survival from smolts to returning spawning escapement. These sites should be considered for development if impoundment rearing proves successful, after production techniques have been further refined.

Table IV-3
*Fish passage at waterfalls and cascades, showing costs and potential escapements*

| Subbasin | Barrier | Stream | Method of Providing Passage | Potential Escapement | Cost of Passage Capital | Cost of Passage An. O&M | Annual Benefit |
|---|---|---|---|---|---|---|---|
| Middle Fork Willamette | Falls at mile 12 | Little Fall Creek | Ladder | 470 Coho<br>300 W. Steelhead | $ 30,000 | $1,800 | $ 7,300 |
| | Falls at mouth | Hills Cr. (lower) | Blast | 420 Coho<br>270 W. Steelhead | 2,000 | - | 6,500 |
| McKenzie | Cascades at mile 1.5 | Lost Creek | Ladder | 70 S. Chinook<br>75 S. Steelhead | 20,000 | 1,200 | 11,000 |
| Santiam | Falls at mile 9.5 | Wiley Creek | Blast | 320 W. Steelhead | 1,300 | - | 2,600 |
| | Falls at mouth | Ames Creek | Blast | 200 Coho<br>130 W. Steelhead | 2,000 | - | 3,100 |
| | Falls at mile 10 | Hamilton Creek | Blast | 70 W. Steelhead<br>40 Coho | 3,000 | - | 1,000 |
| | Falls at mile 70 | Calapooia River | Blast | 40 W. Steelhead | 2,500 | - | 300 |
| | Falls at mouth of Moose Creek | S. Santiam River & Moose Creek | Blast | 380 Coho<br>260 W. Steelhead | 3,000 | - | 6,000 |
| | Falls at mile 63.6 | S. Santiam River | Trap & haul | 70 Coho<br>110 W. Steelhead | - | 1,500 | 1,600 |
| | Falls at mouth | Seven Mile Creek | Trap & haul | 90 W. Steelhead<br>60 Coho | - | 1,500 | 1,400 |
| | Falls at mile 33.2 & Shed Camp Falls | Middle Santiam | Blast | 160 W. Steelhead<br>90 Coho | 11,000 | - | 2,200 |
| Coast Range | Falls at mile .5 | Cosper Creek | Blast | 90 W. Steelhead<br>170 Coho | 3,000 | - | 2,500 |
| | Falls at mile 12 | Willamina Creek | Blast | 280 W. Steelhead<br>210 Coho | 2,500 | - | 4,400 |
| | Falls at mile 1/4 | Wind Creek | Blast | 75 Coho<br>35 W. Steelhead | 1,000 | - | 1,100 |
| | Falls at Fall City | L. Luckiamute | Ladder | 230 W. Steelhead<br>180 Coho | 30,000 | 1,800 | 3,700 |
| | Falls at mile 1.4 | Haskins Creek | Blast | 160 Coho<br>170 W. Steelhead | 2,500 | - | 3,000 |
| Tualatin | Lee & Haines Falls | Tualatin River | Blast Lee<br>Ladder Haines | 470 W. Steelhead<br>270 Coho | 20,000 | 1,000 | 6,600 |
| Clackamas | Cascades at mile 7 | Collowash | Blast | 120 Coho<br>250 S. Steelhead<br>250 W. Steelhead | 13,000 | - | 20,000 |
| | Falls at mile .4 & .6 | Elk Lake Creek | Blast | 100 Coho<br>90 S. Steelhead<br>90 W. Steelhead | 10,000 | - | 7,700 |
| | Falls at mile 1 | Pansy Creek | Blast | 60 Coho<br>120 W. Steelhead | 2,500 | - | 1,600 |
| Molalla | Scotts Mills Falls | Butte Creek | Ladder | 920 W. Steelhead<br>750 Coho | 12,000 | 700 | 15,000 |
| TOTAL | | | | 415 S. Steelhead<br>4,405 W. Steelhead<br>3,825 Coho<br>70 S. Chinook | $171,300 | $9,500 | $108,600 |

Table IV-4

*Estimated benefits and costs of providing fish passage at existing dams and barriers upstream*

| Subbasin | Barrier | Stream | Passage Method | Potential Escapement | Cost of Passage Capital | Cost of Passage An. O&M | Annual Benefit |
|---|---|---|---|---|---|---|---|
| Coast Fork Willamette | Cottage Grove Dam | Coast Fk. Willamette R. | Trap & haul upstream. Downstream passage in reservoir outlet. | 780 W. Steelhead<br>1,100 Coho | $ 300,000 | $ 80,000 | $ 18,000 |
| | Dorena Dam, Wild-wood Falls, & 2 water supply dams on Layng Creek | Row R. & Tributaries | " | 160 S. Chinook<br>670 S. Steelhead<br>1,600 W. Steelhead<br>2,700 Coho | 1,300,000 | 160,000 | 100,000 |
| Middle Fk. Willamette | Dexter, Hills Cr., Lookout Point, & Hines Lumber Co. Dams, and Salmon Cr. Falls | Middle Fk. Willamette R. and tributaries | Trap & haul adults & downstream migrants at Dexter & Lookout Point & Hills Cr. Ladder Hines Lumber Co. dam and Salmon Cr. Falls. | 7,500 S. Chinook<br>7,000 S. Steelhead<br>1,900 W. Steelhead<br>650 Coho | 4,000,000 | 370,000 | 1,150,000 |
| McKenzie | Cougar Dam | S. Fk. McKenzie R. | Trap & haul adults & downstream migrants around dam & reservoir. | 1,500 S. Chinook<br>1,100 Coho<br>2,100 S. Steelhead | 1,000,000 | 160,000 | 280,000 |
| | Blue River Dam | Blue River | " | 1,300 W. Steelhead<br>750 Coho | 400,000 | 160,000 | 18,000 |
| Santiam | Big Cliff & Detroit Dams | N. Santiam R. | Trap & haul adults & downstream migrants around dam & reservoir. | 3,200 S. Chinook<br>900 S. Steelhead<br>2,400 W. Steelhead<br>760 Coho | 2,800,000 | 280,000 | 370,000 |
| Coast Range | Dallas Water Supply Dam | Rickreall Creek | Ladder | 130 Coho<br>120 W. Steelhead | 50,000 | 3,000 | 2,300 |
| Clackamas | River Mill Dam | Clackamas R. | Improve Ladder. | 6,400 S. Chinook<br>2,300 Coho<br>2,700 S. Steelhead<br>2,700 W. Steelhead | 80,000 | 5,000 | 800,000 |
| Sandy | Bull Run Dam 1 & 2 & several falls upstream | Bull Run R. | Trap & haul adults & downstream migrants around dam & reservoir and upstream from falls. | 800 S. Chinook<br>1,100 S. Steelhead | 4,700,000 | 130,000 | 140,000 |
| | Little Sandy Dam & 3 falls. | Little Sandy R. | Ladder dam, blast falls, falls, screen diversion. | 700 S. Steelhead<br>670 Coho | 45,000 | 5,000 | 53,000 |

Table IV-5

*Estimated production and cost of rearing fall chinook salmon at selected impoundment sites 1/*

| Location | Surface Acres | Estimated Production of Smolts 2/ | Estimated Survival Smolt to Spawning Escapement (Percent) | Cost (Dollars) Capital 3/ | Cost (Dollars) An. O&M |
|---|---|---|---|---|---|
| Cascades Gateway Park, Mill Cr. near Salem | 12 | 1,000,000 | 0.055 | 100 | 5,500 |
| Aumsville Feed Mill Diversion | 1 | 1,000,000 | " | 100 | 5,500 |
| 1/2 mile east of Corvallis Builders Supply Co. property | 10 | 1,000,000 | " | 1,000 | 5,500 |
| 1/2 mile east of Corvallis Builders Supply Co. property | 5 | 1,000,000 | " | 1,000 | 5,500 |
| 1 mile downstream from Coburg Bridge, McKenzie R., McKenzie Sand and Gravel Co. property | 5 | 1,000,000 | " | 500 | 5,500 |
| Coast Fk. Willamette R., 1/2 mi. upstream from confluence with M.F. Willamette R., Wildish Sand and Gravel Co. property. Mouth Clackamas River | 10 | 1,000,000 | " | 500 | 5,500 |
| Mouth of Clackamas River | 20 | 1,000,000 | " | 500 | 5,500 |

1/ *Fish Commission of Oregon estimates.*
2/ *All ponds stocked at the same rate, regardless of pond size, until better information on stocking rates become available.*
3/ *Easements could be obtained; thus no land-acquisition costs are shown.*

## Control of Stream Temperatures below Reservoirs

After construction of Dorena and Cottage Grove Reservoirs, salmon and steelhead trout runs were almost completely eliminated from the Coast Fork, apparently as a result of warm water released from these reservoirs. Runs can be reestablished by supplying multiple-level outlets at the dams to control water temperatures downstream. Size of the possible enhancement is shown in the Addendum. Cost estimates for constructing such outlet facilities should be made by the U. S. Army Corps of Engineers, who built and operate the projects.

## Sill Logs

Low flows and insufficient pool area often limit fish production in Willamette Basin streams. By using sill logs, better habitat conditions for fish can be created at relatively low cost per fish produced. With sill logs anchored perpendicular to the current, the space upstream from the log is usually soon filled with gravel, while downstream the water passing over the log creates a pool. Table IV-6 lists some small tributary streams in which sill logs would benefit anadromous fish production, and shows benefits and costs per stream for installing such structures.

Table IV-6
*Benefits and costs of stream improvements by use of sill logs*

| Location | Increased Escapement: Coho | Increased Escapement: W. Steelhead | Capital Cost | An. O&M |
|---|---|---|---|---|
| **Santiam Subbasin** | | | | |
| S. Santiam tributaries: | | | | |
| Shotpouch | 60 | 60 | $ 2,000 | $ 200 |
| Trout | 60 | 60 | 2,000 | 200 |
| Keith | 60 | 60 | 2,000 | 200 |
| S. Fk. Crabtree | 90 | 90 | 3,000 | 300 |
| **Pudding Subbasin** | | | | |
| Molalla R. tributaries: | | | | |
| Gawley | 60 | 60 | 2,000 | 200 |
| Pine | 60 | 60 | 2,000 | 200 |
| Camp | 60 | 60 | 2,000 | 200 |
| Lost | 60 | 60 | 2,000 | 200 |
| Lukens | 180 | 180 | 5,000 | 500 |
| Cougar | 60 | 60 | 2,000 | 200 |
| Total | 750 | 750 | $24,000 | $2,400 |

*Source: Fish Commission of Oregon*

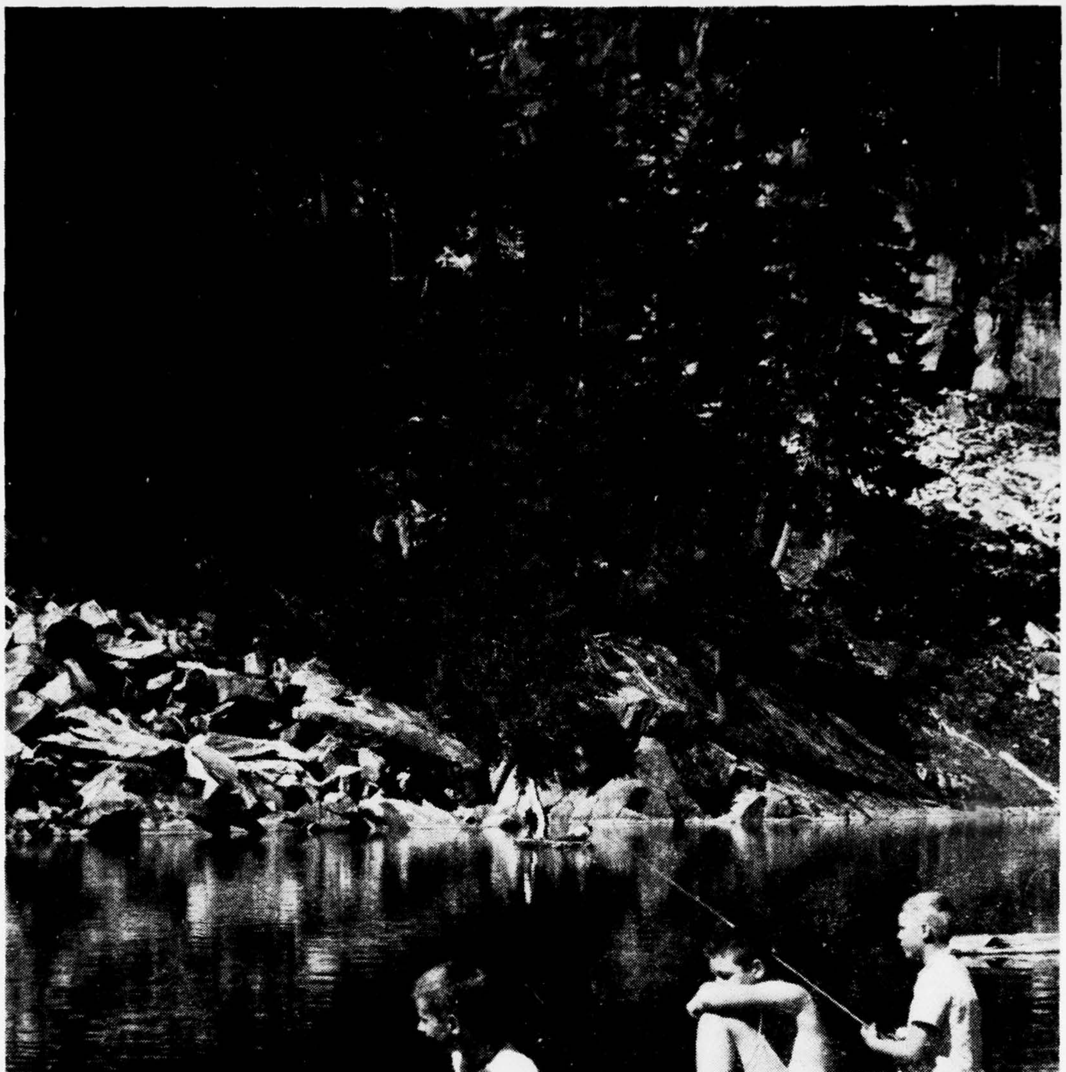


Photo IV-1. Need for fishing impoundment is not as urgent at higher levels as it is near population centers. (U.S. Bureau of Outdoor Recreation photo)

## Resident Fish

### Fishing Impoundments

In some respects, impoundments offer a greater degree of flexibility than natural bodies of water for fishery planning and management. Within certain limitations, they can be constructed near heavily populated areas to help meet present or projected needs. They can also be used to distribute angling pressures by constructing them in easily accessible but sparsely populated areas where there is little or no opportunity for angling at present. Good sites for impoundments, ranging in surface area from 5 acres or less to several hundred acres, occur in many parts of the basin.

Many of these sites can be developed at moderate cost by constructing low earth dams or dikes. Impoundments on the valley floor can be constructed and managed to support both trout and warm-water fish. Those at higher elevations would, in most cases, be stocked with trout.

There are several large impoundment sites near population centers or in areas where rapid population growth is projected. These sites should be acquired and developed soon. Good sites will be overrun and lost if urban areas are allowed to surround them before they are developed.

Many good sites also occur at higher elevations in both the Cascade and Coast Ranges. Need for impoundments is not as urgent here as near population centers, but these locations offer several important advantages. Many are in National Forests or on other public forest lands. Recreational opportunities offered by forest surroundings are often enhanced by creating an impoundment. Even with heavy use, such areas usually offer more restful surroundings than sites near large population centers. Anglers planning vacation trips of several days would be especially drawn to these sites.

Table IV-7 lists a number of possible sites that would be desirable for development as fishery impoundments. Distribution of these sites is shown on Figure IV-1. Table IV-7 includes sites which have been identified and which offer good potential for fishery development, but it is not intended to be a list of all the good impoundment sites in the basin. Fishery benefits and construction costs will vary depending on location, size, and purpose of these impoundments. The range of costs and annual benefits is shown below:

| | Benefits | Cost | |
|---|---|---|---|
| Location | Angler-Days Per Acre | Capital Cost Per Acre | Annual O&M Per Acre |
| Near population centers | 40-50 | $700-$1,200 | $5-$20 |
| Mountain sites | 20-40 | $500-$1,200 | $1-$2 |

Table IV-7
*Representative fishing impoundment sites*

| Site | Number on Map IV-1 | Surface Area (Acres) | Location Sec | T | R |
|---|---|---|---|---|---|
| Rock Creek | 1 | 210 | 18 | 1N | 1W |
| Fanno Creek trib. | 2 | 105 | 34 | 1S | 1W |
| Johnson Creek trib. | 3 | 130 | 26 | 1S | 3E |
| Bledsoe Creek | 4 | 310 | 27 | 2N | 3W |
| Rock Creek | 5 | 700 | 17 | 5S | 1E |
| Spring Valley Creek | 6 | 100 | 26 | 6S | 4W |
| Drift Creek | 7 | 340 | 36 | 7S | 1W |
| Maxfield Creek | 8 | 150 | 14 | 10S | 6W |
| Bear Branch | 9 | 210 | 28 | 9S | 1W |
| Gordon Meadows | 10 | 150 | 10 | 14S | 4E |
| Park Creek | 11 | 250 | 6 | 13S | 7E |
| Big Meadows | 12 | 150 | 28 | 12S | 7E |
| Coyote Creek | 13 | 1,070 | 14 | 19S | 5W |
| Scott Lake | 14 | 40 | 34 | 15S | 7-1/2E |
| Four Hills | 15 | 22 | 9 | 18S | 2E |
| Heather | 16 | 20 | 16 | 22S | 5E |
| Waterdog Lake | 17 | 10 | 21 | 22S | 4E |
| Sunset Creek | 18 | 10 | 29 | 24S | 5-1/2E |
| Glenbrook Pond | 19 | 10 | 34 | 14S | 6W |
| Cosper Creek | 20 | 40 | 19 | 5S | 7W |

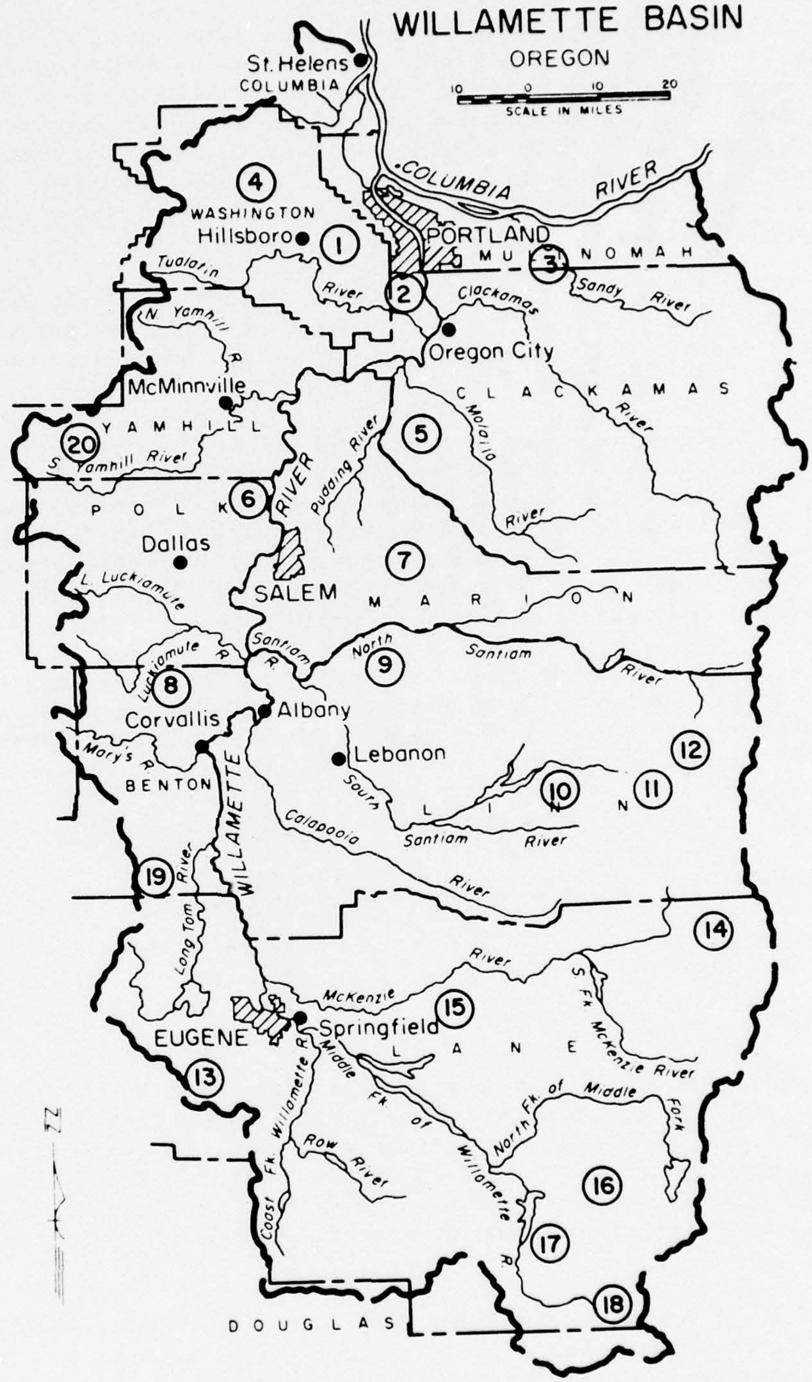



*Figure IV-1. Distribution of selected impoundment sites.*

## Lowland Lakes

Willamette Basin contains many oxbow lakes, especially along Willamette River. Part II - Present Status, lists a number of these lakes, many of which can be converted into good fishing areas at a relatively low cost. Developments needed generally include dams or dikes to divert floodwaters, and screens or other devices to prevent contamination by nongame fish entering through inflow or outflow channels. Also, for most areas it would be necessary to eradicate nongame fish, restock with desirable species, and provide public access.

Oxbow lakes near large population centers should be acquired and developed soon. As with the impoundment sites, these lakes will be lost to the general public if urban areas are allowed to surround them before they are developed for sport fisheries.

There would be several advantages if these lakes were systematically developed. Acquiring access and developing the lakes would normally cost less than creating new impoundments. The lakes would be in harmony with the Willamette River system (Greenway) and with the flood plain management concept. Fish can be provided at low cost because warm-water fish populations are usually self-sustaining. Trout could be stocked in some of the lakes for those who prefer trout fishing.

Cost of developing lakes for public fishing will vary depending on location and degree of development. The following tabulation lists the range of benefits and costs; benefits shown are average annual benefits for the period of analysis:

| Development | Benefits Angler-Days Per Acre | Costs (Dollars per acre) Capital Cost | Annual O&M |
|---|---|---|---|
| Access only | 10-15 | 15-50 | 1-2 |
| Full development | 40-50 | 400-750 | 5-20 |

## High Mountain Lakes

About 400 high lakes in Willamette Basin can be used for trout fishing. Most of these lakes are in the Cascade Range. Some of them support self-sustaining populations of trout. Many are stocked by plane with fingerling trout. Improved access is being planned for many of the lakes and in some cases has already been provided or is under construction. Much of this improvement is included in forest management plans.

Most of the lakes are presently underfished and probably will continue to be underfished at least through 1980. Stocking larger numbers of fingerling trout in the productive lakes should provide enough fish to meet angler needs through the study period.

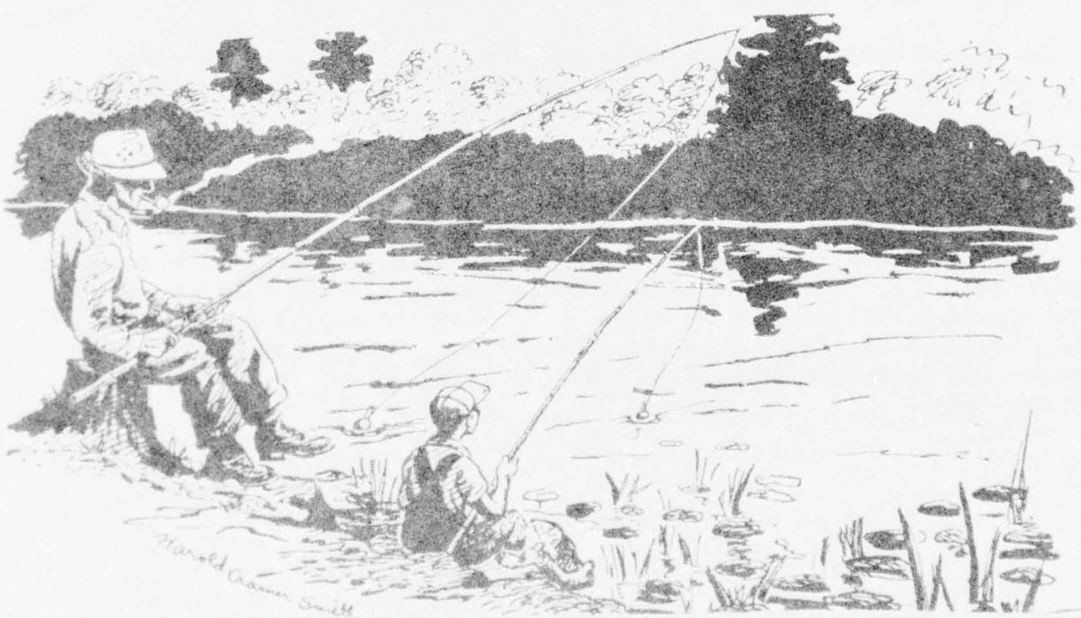
## Control of Nongame Fish in Large Reservoirs

Ten large reservoirs in Willamette Basin were open to public fishing in 1965. Estimated angler-use at these reservoirs was 150,000 angler-days. Construction of additional large reservoirs could result in substantial increases in angler-use. However, nongame fish often over-populate such reservoirs, reducing or eliminating angler use within a few years.

Chemical eradication and control of nongame fish and annual stocking of game fish is necessary to develop and maintain a reservoir sport fishery. The cost of stocking is estimated to be $12 per surface acre. Chemical-eradication costs will need to be determined for each specific project. The following tabulation indicates the amount of benefits that can be realized:

| | Projected Annual Benefits (per surface acre) | | |
|---|---|---|---|
| | 1980 | 2000 | 2020 |
| Angler-days | 10 | 13 | 20 |
| Value | $20 | $26 | $40 |

Angler-use that would result from treatment of Lookout Point or Dexter Reservoir, which have never been treated, and from treatment of reservoirs constructed after 1965, would help meet projected demands. Increased use resulting from retreatment of the reservoirs existing before 1965 is included in the projections (Part III) because the supply of fish is projected on the assumption that these reservoirs will be relatively free of nongame fish throughout the period of study.



## Sport Fisheries in Farm Ponds and Borrow Pits

Small fishing impoundments are making important contributions to the sport fisheries of Willamette Basin. In 1967, there were more than 500 private fish ponds averaging 5 surface acres each. In addition, the basin contained an estimated 3,200 ponds with a total surface area of about 3,200 acres, constructed for purposes other than fishing. Many of these ponds can be developed for fishing, although minor changes will be required in most cases to improve fish habitat. Public access would be desirable in some cases.

Farm ponds can support from 40 to 50 angler-days use per surface acre annually throughout the period of study. Access costs range from $500 to $1,000 per pond. Stocking costs for trout ponds is about $12 per surface acre. Little or no stocking will be required for warm-water fish. Other operation and maintenance costs will be minor.

Borrow pits are similar to farm ponds for potential fishery use. Some borrow pits are already producing warm-water fish and others can easily be made productive; with proper management, trout can also be raised. Where new highways are being constructed, advance planning would help assure many more borrow-pit fish ponds. Benefits, cost of access, and management costs are similar to the estimates for farm ponds.

## Sill Logs

Small, shallow streams which at present support few resident fish can be made more productive by installing sill logs. Creating new pools or enlarging existing pools can provide more stream area to be stocked with trout. Natural reproduction of both trout and warm-water species can also be increased under favorable conditions.

Estimated annual benefits would be from 10 to 20 angler-days per sill log, depending on size and location of the stream. Capital costs range from $50 to $150, and annual operation and maintenance costs from $5 to $15, per sill log.

## IMPROVED ANGLER ACCESS

For most public water-development projects, angler access is included as part of the project plan. Access to natural bodies of water is sometimes provided incidentally as a result of road construction. In other cases, roads or trails must be constructed and land acquired to provide access. The following discussion points out several areas where access problems exist.

## Streams

Stream fishing is popular in Willamette Basin, and readily accessible areas are usually overfished. Some small streams and some reaches of larger streams are comparatively isolated, either because of rugged terrain or because the stream is bordered on both sides by private property. A good potential to meet increased angler needs exists in these isolated reaches. Small boats can be used to float reaches of some streams where other access is not feasible. Access needs vary from parking spaces for a few cars to areas of several acres with boat ramps and parking lots.

Oregon State Game Commission is preparing a comprehensive plan for improving public access to the major stream system of Oregon. Development of any of these sites will result in increased angler use. Benefits will depend on whether the site provides improved access to a reach of stream already in use or opens a reach receiving little or no use at present. The average angler use of a 100-car site will be about 25,000 angler-days annually throughout the period of study.

Costs for providing access will vary according to location and needs. Small roadside parking sites can be provided at costs of $500 to $1,500. Average cost of developing a boat-launching area to accommodate 100 cars and boat trailers is about $50,000. The average area would include about five acres of land, a boat-launching ramp, a parking area, and sanitation facilities.

## Municipal Water-Supply Watersheds

Several municipal watersheds, which include about 1,150 acres of impoundments and many miles of streams, are closed to public access, mainly to protect against pollution and contamination. In other parts of the country, some cities with closed watersheds have opened them to the public with satisfactory results. Future angler needs could lead to a change of policy by some Willamette Basin cities so that closed watersheds will be opened for public fishing, hunting, and general recreation.

Angler use of municipal water-supply impoundments would be higher than the average use projected for Willamette Basin impoundments as a whole because they are located near large population centers. Projected use for all municipal supply impoundments is 12,000 angler-days in 1980, 16,000 angler-days in 2000, and 23,000 angler-days in 2020. Major costs would be for providing public access at an average of $50,000 per site at large impoundments, and stocking with trout at about $12 per surface acre.

## ARTIFICIAL PROPAGATION

Artificial propagation includes the use of fish hatcheries and spawning channels to produce fish. The emphasis is on fish hatcheries since they show more promise than spawning channels in Willamette Basin.

Possibly the most serious problem in establishing a fish hatchery has been locating a dependable water supply of suitable quality and quantity. Recent research on recirculation of hatchery water indicates that water supply needs can be met in the future.

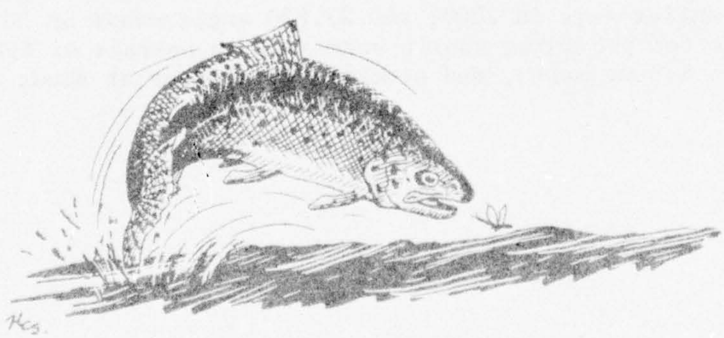
Table IV-8 indicates the general hatchery costs for producing anadromous and resident fish. These figures can be used to compute hatchery cost if other alternative methods fail to meet all fishery needs.

If fish hatcheries are considered as an alternative, about $50,000 will be necessary for studies to locate the most suitable hatchery sites and water supplies. All existing hatcheries may have room for expansion.

Table IV-8
*Capital and annual hatchery costs*

| | Capital Cost | Annual Operation & Maintenance |
|---|---|---|
| Anadromous Fish: 1/ | | |
| Spring chinook | $200,000 | $22,000 |
| Fall chinook | 180,000 | 20,000 |
| Coho | 60,000 | 7,000 |
| W. steelhead | 150,000 | 14,000 |
| S. steelhead | 290,000 | 27,000 |
| Resident Fish: 2/ | | |
| Trout | 20,000 | 2,000 |

1/ *Per thousand spawning escapement*
2/ *Per thousand angler-days*



## FISH ENHANCEMENT PROGRAMS OF FEDERAL LAND MANAGEMENT AGENCIES

Forest Service and Bureau of Land Management have improvement, protection, and management responsibilities for cold water stream and lake habitat under their administration in Willamette Basin. Table IV-9 indicates the habitat development program proposed by Forest Service.

Table IV-9
*Fish habitat improvement programs of U. S. Forest Service*

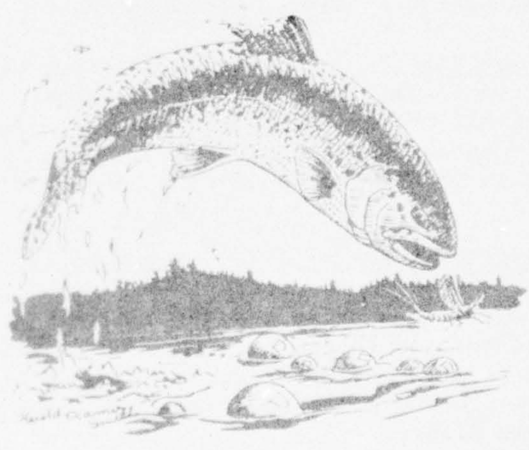
| Program | Unit | 1980 No. | 1980 Cost ($1,000) | 2000 No. | 2000 Cost ($1,000) | 2020 No. | 2020 Cost ($1,000) |
|---|---|---|---|---|---|---|---|
| Stream Improvement | Mi. | 20 | 40 | 30 | 60 | 30 | 60 |
| Lake Improvement | Ac. | 620 | 465 | 820 | 615 | 800 | 660 |
| Total | | | 505 1/ | | 675 | | 720 |

1/ *Upper Area $65,000, Middle Area $273,000, Lower Area $167,000.*

In addition, the Service has proposed 440 miles of stream surveys at an estimated cost of $14,000, and 6,290 acres of lake surveys at an estimated cost of $50,000 during the initial development period.

Bureau of Land Management expects to construct 10 miles of artificial spawning channels during the initial development period and improve spawning beds in 20 miles of stream in each of the 3 periods.

Neither costs nor benefits of Forest Service or Bureau of Land Management development programs have been estimated but satisfaction of some of the needs indicated in Part III may be anticipated from them.



## INVESTIGATION NEEDS

Some possible developments for fish, as well as costs and benefits of such developments are indicated above. This is not, however, a detailed plan for fishery development, and it varies in depth and quality with the store of available knowledge about specific features.

Investigation and research are urgently needed in order that a detailed, complete, tributary-by-tributary plan for fish may be formulated for the basin, and means for implementing the plan developed. This should, ideally, be a cooperative effort among the State and Federal fisheries agencies, the land-managing agencies, local sportsmen and sportsmen's groups, and (for certain phases) the construction agencies.

Refinement of optimum flow data. Although for certain stream reaches optimum flow requirements for fish have been established with some accuracy, for others much more field investigation must be undertaken before flow requirements either for fish production or for fishing can be delineated with accuracy.

Effects of reservoirs on quality of downstream flows. Several reservoir sites in Willamette Basin contain areas of unstable soils subject to slumping and washing. When large amounts of colloidal particles enter a reservoir through slumping of side slopes or washing of shorelines, both the reservoir and the stream below may stay cloudy. This, of course, restricts fish production, and limits fisherman use. Detailed field and laboratory work will be necessary to determine if reservoirs being considered by the construction agencies will in fact be beneficial to fish, or will cause irreparable damage.

Passage of fish at high dams. Successful fish passage has been accomplished at some high dams in the Pacific Northwest. There have, however, been several, spectacular failures. Research on several aspects of fish passage is underway but in view of the large number of high dams considered for the basin, as well as the number presently blocking large areas of spawning and rearing habitat, fish-passage research and evaluation should be accelerated.

Eradication of nongame fish. The lower sections of many Willamette Basin streams produce mainly nongame fish. These areas might produce large numbers of salmonids if competing nongame fish were eliminated. This method of increasing production needs to be evaluated as to its feasibility and as to the length of time before critical reinfestation will occur.

Barrier dams to prevent nongame fish from entering rehabilitated stream sections. Research is needed to determine a type of structure that will pass anadromous salmonids but stop nongame fish. Such structures could be used in conjunction with artificial feeding of anadromous fish in streams, eradication of nongame fish in stream sections, and to protect areas upstream from reservoirs from infestation by nongame fish.

Artificial feeding and rearing of anadromous fish. Anadromous fish have for a number of years been raised to smolt size in hatchery ponds. Recent experimental rearing in small reservoirs shows promise and is continuing. Large reservoirs could be used to rear large numbers of downstream migrants if artificial feeding proves feasible in such reservoirs. Research to explore the feasibility of such rearing is desirable. A good reservoir site for study would meet the following requirements:

1. The reservoir should be new to enable the study to cover the different phases of fish production. New reservoirs generally have higher fish production than older reservoirs.

2. The reservoir should have a short watershed so that predatory fish population control, if such control is necessary, will be simplified.

3. The reservoir should not have a sport fishery. Ordinarily, only a new reservoir will fit this requirement.

4. Generally, the reservoir should not be deeper than 200 feet or of greater surface area than 2,000 acres.

5. The reservoir should have a stream-level outlet and be capable of being completely drawn down by fall.

6. The impoundment site should be "V-shaped" in cross section and free of depressions to prevent stranding of migrants when the water is released.

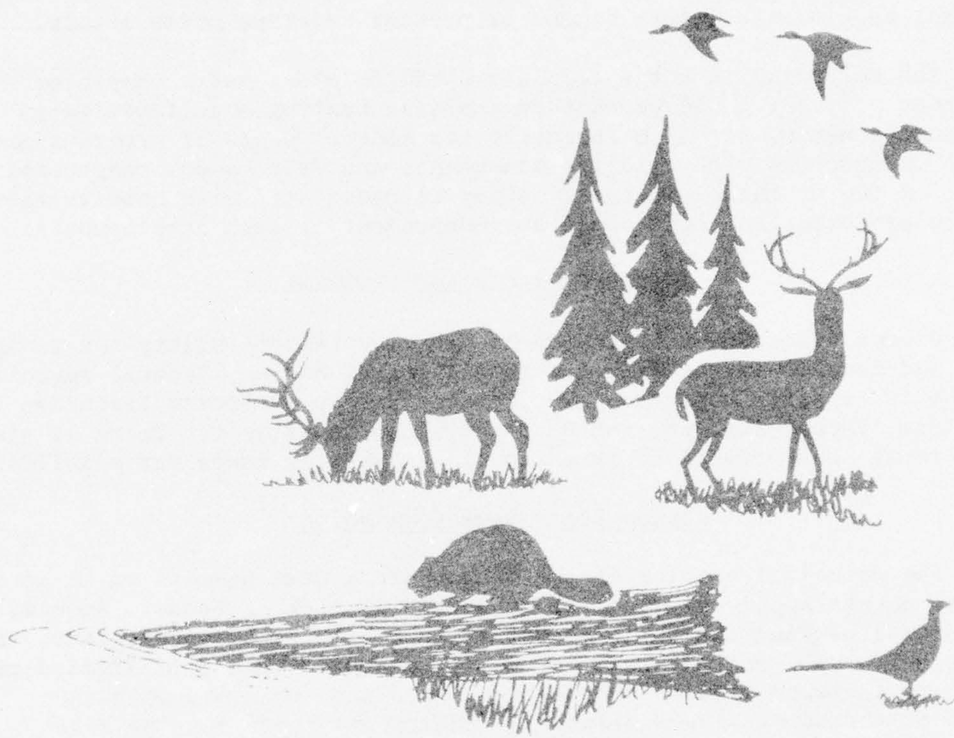
Juvenile anadromous fish often have difficulty migrating through large impoundments. As a result, some of these fish do not migrate to the sea to complete their life cycles. However, research on impoundment rearing of anadromous fish suggests that they can be reared in reregulating reservoirs such as Big Cliff and Dexter on North Santiam and Middle Fork Willamette Rivers, respectively. In contrast to most impoundments, the reregulating reservoirs are relatively small in cross section and pass large volumes of water daily, so lack of guiding flows will probably not be a problem. Chemical eradication of predatory species and stocking of fry will be necessary. Facilities to trap the returning adults are already present near each dam.

Benefits cannot be calculated at this time because additional research is needed on at least two basic problems: (1) the possibility of premature emigration of fingerling anadromous fish from the reservoirs; and (2) in Dexter Reservoir, the probability of continual reintroduction of nongame fish from untreated waters upstream.

There is evidence that presmolt, hatchery-reared, coho salmon planted late in the spring will not distribute themselves to make full use of stream environment. The feasibility of feeding them artificially in the stream to produce smolts with a high survival rate should be investigated.

Sea-run cutthroat trout management investigations. Sea-run cutthroat are an underdeveloped fishery resource of Willamette Basin. These fish are present in the Willamette River system, but little is known about the size or extent of the run. An investigation should be made to gather more information about the run, find ways to increase the run, and develop a plan to publicize the fishery.

# WILDLIFE



## GENERAL

This part is concerned with projects and programs designed to aid in reducing the unsatisfied needs described in Part III. No attempt is made to balance wildlife populations with demand, but the alternative means presented in this section should reduce the spread between populations and demand. For most wildlife species, populations will not keep pace with demands, particularly in the later years of the study period, without vastly increasing programs of habitat development, access development, research, and investigation, or alternatively, without reducing demands by raising the costs to the beneficiaries.

Numbers of forest-dwelling species, black-tailed deer, elk, black bear and grouse may more nearly match the demand than numbers of other species, because much of their habitat is on public land and funds may be supplied for habitat improvement as a public good. For most upland game and waterfowl, however, both political and financial factors weigh against meeting the future demand at present relative price levels.

The following is not a complete wildlife plan, but a sample of alternatives that could be used to increase hunting opportunities in Willamette Basin. It also indicates the general scope of programs and plans of agencies with wildlife management and development responsibilities. A few of these alternatives may be associated with construction agency projects, but most would be independent of such developments.

## AGENCY PROJECTS AND PROGRAMS

Oregon State Game Commission has primary responsibility for management and development of wildlife in Willamette Basin. Federal agencies active in wildlife management include the Bureau of Sports Fisheries and Wildlife, Forest Service, and Bureau of Land Management. There is also opportunity for private entities to aid in meeting needs for wildlife.

### Oregon State Game Commission

The principal problem of the Oregon State Game Commission in attempting to equate supply of wildlife to demand is lack of funds. Acquisition or control of land, which is essential to most habitat development, and construction in general, have become so expensive that only limited programs to increase wildlife populations have been possible with the funds at the Commission's disposal. Additional funds must be made available before projects and programs for development of wildlife resources and hunting opportunities indicated here can be undertaken.

Basic steps in increasing the number of hunting opportunities in Willamette Basin would be to implement programs of research, investigation and education to determine the preferences and reactions of the public to various management programs, and to obtain informal support from both sportsmen and landowners for development programs. The initial outlay for such investigations is estimated to be $750,000, and $10,000 annually would be required to sustain them. These investigational programs could be expected to result in increased numbers of all wildlife and in a direct increase of 60,000 big game hunter-days, 50,000 upland game hunter-days, and 25,000 waterfowl hunter-days. These increases would result primarily from improved hunter-landowner relations and more efficient control of hunting pressure.

A computerized simulation of wildlife populations could be used to predict and evaluate effects of habitat manipulation, harvest control, and other management techniques. This program would be aimed at deer, elk, band-tailed pigeon, mourning dove, pheasant, quail and waterfowl populations. Estimated cost would be $17,000 for investigations, $250,000 for initial acquisition of materials, $300,000 for data assembly, and $30,000 annually for operation and maintenance. As a direct result of such a computer program, estimated increases of 70,000 big game hunter-days, 70,000 upland game hunter-days, and 20,000 waterfowl hunter-days could be realized, primarily by optimized harvesting efficiency, habitat and shooting-ground development, and improved distribution of hunting pressure.

The following proposals for acquisition and development would complement the research and investigational programs:

1. Acquisition of flood plain lands. Under this program, undeveloped or unused flood plain land with high potential for producing wildlife would be identified. This land could be acquired at the same time as the Willamette River Park System (Greenway) or other wildlife-land acquisition programs.

   Opportunities for hunting all Willamette game species except elk would increase under this program, and there would be incidental benefits from fishing, boating, camping, horseback riding, picnicking, nature walks, trapping, berry picking and other outdoor recreational pursuits. Cost of investigations for the program would be approximately $25,000; the cost would be somewhat less if this program were studied simultaneously with other land-acquisition investigations. Costs would be an estimated $100 per acre for acquisition, $2 per acre for construction, and $2 per acre annually for operation and maintenance. Wildlife benefits would average 4 upland-game hunter-days, one and one-half waterfowl hunter-days, and one-half big-game hunter-days per acre annually. Incidental benefits could be quite large depending on the extent of specific developments.

2. <u>Leasing of pigeon springs</u>. Opportunities for hunting band-tailed pigeons are available at several rather widely dispersed mineral springs. Most of these springs are on private land, and public access for hunting is frequently limited. Some of the shooting grounds are overcrowded and dangerous, and become littered and unsightly. Game is wasted at many of these areas, and this is likely to continue under present conditions.

   This program would include a survey of pigeon springs in the basin and acquisition or leasing of the most valuable areas. Development and management of the springs would provide substantial benefits through the enhancement of pigeon populations, the control of hunter distribution, and the provision and regulation of public shooting. The cost of this program would be an estimated $10,000 for investigations, $500 each annually for leasing, $1,200 each for construction, and $200 each annually for operation and maintenance. The program would increase use by pigeon hunters an estimated 5,000 days and incidental uses such as bird watching 3,000 days annually.

3. <u>Acquisition of waterfowl refuges and management areas</u>. Waterfowl hunting, as measured by the sale of duck stamps, has decreased markedly in the past 20 years. This is the result of decreases in waterfowl habitat and places to hunt, the establishment of duck clubs restricting hunting to members, and probably other factors that are not readily apparent.

   This program would include acquisition and development of land to provide waterfowl refuges, nesting, resting, and feeding areas, and public shooting grounds.

   Cost of this program would be an estimated $200 per acre for acquisition and initial development, $10,000 for investigations, and $100,000 annually for operation and maintenance. Habitat for nearly all wildlife species in Willamette Basin would be improved, particularly upland game and waterfowl. An increase of 30,000 waterfowl hunter-days and 10,000 upland game hunter-days could be realized. Incidental benefits could amount to as much as 20,000 days for fishing, 50,000 days for nature walks (primarily bird watching) and 800 days for trapping. Pleasure boating, swimming, picnicking and other activities could also take place if they could be accommodated without interfering with the primary purpose of the program.

4. Increased hunter access to farmlands. Most game lives and is hunted on private lands. Although the landowner has no greater claim to the ownership of wild animals than anyone else, he frequently restricts public hunting, and thus controls the use of resources that he does not own. This leads to crowding of hunting areas, vandalism, trespass, and access fees that put hunting as recreation out of reach of the average hunter. Under the proposed program, contracts would be executed with landowners to secure access for hunting in exchange for State Game Commission control of hunting pressure, trespass, and vandalism. An estimated 300,000 acres in three separate locales could be placed under contract. The program would have an initial cost of an estimated $75,000 for investigations, and an annual operation and maintenance cost of $72,000. Benefits are estimated to be 150,000 days of pheasant, quail, rabbit, squirrel, dove and pigeon hunting annually. Incidental recreation benefits could also occur, depending on the willingness of the individual landowner to allow access, and on the provision of facilities.

5. Purchase of rights to hunt upland game and waterfowl. Under these programs, access rights to upland-game and waterfowl habitat would be purchased. Purchase of rights to hunt upland game could be used as either a supplement or alternative to providing increased hunter access to farmland through contractual arrangements.

   Highly productive, key upland-game habitat would be managed for production of game and for hunting. Natural production would be supplemented with artificially propagated stock. About 30,000 acres of land in three separate areas would be managed, controlled and stocked. Estimated initial costs would be $60,000 for investigations, $1,500,000 for acquisition, and $60,000 for construction. An estimated $50,000 would be required annually for operation and maintenance, which would include posting, patrolling, habitat management, and artificial propagation. This program would produce an estimated 60,000 hunter-days use and incidental recreation benefits depending on the willingness of the landowners and the provision of facilities.

   There is relatively little opportunity for those who do not belong to hunting clubs to hunt waterfowl in Willamette Basin except at the 5 State Game Management areas, and at the 3 National Wildlife Refuges, a program to purchase access rights to private waterfowl-hunting developments would broaden hunting opportunities. This program would not result in large increases in total waterfowl-hunting opportunity in the Basin, but it would permit better dispersal and control of hunters and would also allow a larger number of hunters to participate. Initial

costs would be an estimated $6,000 for investigations, $1,500,000 for acquisition, and $15,000 for construction. Operation and maintenance costs would be $40,000 annually, to be paid by user fees. Annual benefits would be an estimated 10,000 waterfowl hunter-days, 15,000 bird-watcher days, and 500 trapper-days.

6. Provision of hunter access to private forest land. Several of the larger timber companies in Willamette Basin allow hunter access to their lands both as a public relations gesture and to reduce game damage to young forest trees. Other timber operators are reluctant to follow this policy because of the risks of fire or vandalism, or the fear of public interference with logging operations.

   Under the program, contracts would be negotiated with timber companies and farmers to provide free hunter access in exchange for State Game Commission control of hunter dispersal, trespass, and vandalism. About 1.5 million acres of forest land in 16 localities could be included in this program. Estimated initial cost would be $25,000 for investigation. Annual operation and maintenance would cost 100,000, mostly for posting and patrolling.

   This program would result in increased benefits estimated at 50,000 big game and 10,000 upland game hunter-days annually. Other benefits such as increased fishing, hiking, picnicking, and bird watching could be obtained if landowner cooperation were secured and facilities provided. Incidental benefits in big game and upland game hunter-days would also result because additional Federal land would be opened to hunters; these lands are not now accessible because access to them is only through private land.

7. Acquisition and Development of Lowland Lakes. This is primarily a fisheries development program but substantial waterfowl hunting benefits would accrue incidentally. Approximately 30 lakes would be acquired and approximately half of them would be furnished with water-control structures during the 50-year development period. Costs for initial acquisition and access development are carried under ALTERNATIVE MEANS TO SATISFY DEMANDS--FISH.

   Estimated annual waterfowl hunter-use benefits of this program will reach 2,000 days by 1980, 4,000 days by 2,000, and 6,000 days by 2020.

8. Stabilization of Fern Ridge Reservoir level. Fern Ridge Reservoir, at a low elevation on the Long Tom River near Eugene, is the only large reservoir in the basin that has proven to be good waterfowl habitat. Stabilization of the reservoir level would enhance waterfowl production and use as well as other reservoir recreation activities. Costs have not been determined. Estimated benefits are 7,500 waterfowl hunter-days, with incidental benefits of 240 bird-watching and 60 trapping days.

9. Fern Ridge Reservoir water. On shallow marshlands waterfowl production, as well as waterfowl and hunter distribution, can be greatly improved by an adequately planned and constructed system of dikes and canals. This program would provide orderly water distribution in waterfowl management area marshlands at Fern Ridge Reservoir. Initial costs are estimated to be $15,000 for investigation, and $200,000 for construction. Annual operation and maintenance cost is estimated to be $7,500. Estimated annual benefits would be 15,000 waterfowl hunter-days, 1,800 bird-watching days and 100 trapping days.

## Bureau of Sport Fisheries and Wildlife

The only BSFW program with physical development in Willamette Basin involves establishing the three-unit William L. Finley National Wildlife Refuge including Finley (5,370 acres) south of Corvallis, Ankeny (2,785 acres) south of Salem, and Baskett Slough (2,650 acres) northwest of Dallas. Objectives are to restore once-drained marshes and ponds, and to produce wildlife foods. About 1,200 acres of seasonal marshes and 275 acres of small ponds will be developed, and 5,400 acres of cropland will be farmed for food production. Approximately 10 parking areas, 30 miles of trails, several miles of access roads, photographic and hunting blinds, 3 display pools, and 3 picnic areas will be included. Development costs for the 3 refuges, exclusive of the cost of land, are estimated to be $786,000. Annual operation and maintenance cost is estimated to be $134,000.

Though the primary purpose of these refuges is to protect dusky Canada geese, most other wildlife species of the basin would also benefit. Increased use of these areas by hunters, hikers, bird watchers, photographers, picnickers, and general recreationists is anticipated.

The management goal is to provide habitat to support 2,400,000 goose-use days, 20,000,000 duck-use days, and 18,000 swan-use days annually, with peak populations of 20,000, 150,000, and 200 birds, respectively. Adequate facilities to accommodate 275 waterfowl hunters at one time are planned.

## U. S. Forest Service

The Forest Service administers more than two million acres of land in Willamette Basin, most of it forested. There are a few small tracts near the crest of the Coast Range, but most of it is on the west slope of the Cascades, much at fairly high elevations. Forest Service lands are fairly well consolidated, although some private and Bureau of Land Management land are intermingled along the west side of the national forest boundaries, and along the Middle Fork Willamette, the McKenzie, North and South Santiam, and Sandy Rivers.

Incidental wildlife benefits will accrue from several programs such as construction of roads and campgrounds, consolidation of holdings, and erosion control. Plans directly related to wildlife habitat improvement and management are indicated in the following table. Benefits have not been determined.

Table IV-10
*Wildlife habitat improvement programs of U. S. Forest Service*

| Program | Unit | 1980 No. | 1980 Cost ($1,000) | 2000 No. | 2000 Cost ($1,000) | 2020 No. | 2020 Cost ($1,000) |
|---|---|---|---|---|---|---|---|
| Seeding & planting | Ac. | 1,300 | 130 | 1,700 | 170 | 1,700 | 170 |
| Forage release | Ac. | 1,800 | 45 | 2,300 | 58 | 2,300 | 58 |
| Permanent openings | Ac. | 410 | 41 | 540 | 54 | 530 | 53 |
| Guzzlers | Each | 10 | 10 | | | | |
| Shallow impoundments | Ac. | 130 | 98 | 170 | 128 | 160 | 120 |
| Develop plantings for waterfowl | Ac. | 60 | 6 | 70 | 7 | 70 | 7 |
| Develop potholes | Each | 10 | 5 | 10 | 5 | 10 | 5 |
| Develop waterfowl nesting facilities | Each | 120 | 6 | 180 | 9 | 160 | 8 |
| Totals | | | 341 | | 431 | | 421 |

During the initial 10 to 15 years of the development period, the Forest Service also plans to complete big game range analysis on 1,134,100 acres of land at an estimated cost of $113,000; small game habitat surveys on 1,600,000 acres at an estimated cost of $80,000; and complete 24 habitat management plans at an estimated cost of $12,000.

## Bureau of Land Management

The BLM administers approximately 420,000 acres of public land in Willamette Basin. These lands are the Public Domain plus the Oregon and California Railroad revested (O&C) lands. The BLM lands can produce more wildlife benefits per acre than the national forests because they are generally more naturally productive, lower in elevation, and are closer to population centers than most national forest lands. Although some BLM land holdings are blocks of several sections, many tracts are interspersed with, or entirely surrounded by, private lands.

Long-range plans for wildlife management and development on Bureau of Land Management lands are evolving and far from complete. However, a major effort will be made to provide better access for hunters, fishermen, and general recreationists. A serious handicap to the use of some BLM lands has been their scattered ownership pattern; as a result, intermixed private lands have blocked access to public lands. A related handicap has been the inability of the public to distinguish between public and private lands. Thus a section of land may be readily accessible and open to hunting but may receive little or no public use because the public is not aware that it is publicly owned. The following projects and programs would help open up BLM lands for hunting, fishing, and general recreation:

1. Post BLM lands so that hunters, fishermen and recreationists may know which lands are open for their use. This would require locating and posting about 800 separate tracts in Willamette Basin. Estimated cost is $10,000 annually; benefits have not been estimated.

2. Construct access roads for hunters, fishermen, and recreationists. An estimated 5 miles of key access roads would be constructed annually, at a cost of $15,000 per mile. Benefits have not been estimated.

3. Provide public access through private lands. The need for this program has become evident because of private control of access to public lands east of the Cascades in Oregon, and in other western states. It is expected that the public will eventually demand access to all public lands with associated recreational or fish and wildlife resources in Willamette Basin. The magnitude of the program necessary to provide this access has not been determined, nor have costs or benefits been estimated.

In addition to specific programs designed to promote more efficient use of wildlife resources on public lands, Bureau of Land Management has proposed watershed protection and flood control measures that will furnish incidental wildlife benefits (Table IV-11). Neither costs nor benefits of these measures and practices has been determined.

Table IV-11

*Proposed measures and practices for lands administered by Bureau of Land Management 1/*

| Measure or Practice | Units | 1980 | 2000 | 2020 |
|---|---|---|---|---|
| 1. Revegetation with trees and shrubs | acres | 10,000 | 12,000 | 4,000 |
| 2. Revegetation with grass | acres | 20 | | |
| 3. Brush control | acres | 1,500 | 1,800 | 1,000 |
| 4. Fertilizing | acres | 400 | 5,000 | 5,000 |
| 5. Conversion of tree cover to grass | acres | | | 1,500 |
| 6. Contouring, pitting, furrowing | acres | 100 | | |
| 7. Stream and bank stabilization | acres | 15 | 35 | 80 |
| 8. Irrigation | acres | 125 | 700 | 1,000 |
| 9. Establishment of timber reserve areas | acres | 820 | 880 | 1,130 |
| 10. Cut and fill stabilization on roads | miles | 1,166 | 1,412 | 448 |
| 11. Stream clearance | miles | 45 | 68 | 61 |
| 12. Pollution abatement | miles | 35 | 5 | 5 |
| 13. Construction of ponds and reservoirs | number | 10 | 30 | |
| 14. Prescribed burning | acres | 5,290 | 3,500 | 500 |

1/ *Date indicates end of period during which measure or practice will be installed.*

## The Private Sector

Activities of private individuals and groups are expected to help satisfy demands for some species of wildlife, but to reduce supplies of others. (Factors serving to decrease wildlife habitat are presented in Part III.) Large areas of privately owned land now closed to hunting are expected to support hunter-use, probably on a fee basis, when the demand for places to hunt becomes great enough to make opening such areas profitable to the owners. Much of the other privately owned wildlife habitat may also be managed for hunting on a fee basis. This will undoubtedly stimulate landowners to improve wildlife habitat and increase supplies of game, but it may or may not increase hunter-use depending on whether or not hunting was previously permitted and how many hunters would be willing to pay for the privilege of hunting.

Several governmental agencies have, or propose, programs aimed at increasing game abundance or hunter-use on private lands. The State Game Commission programs proposed for private lands are mentioned above. The U. S. Soil Conservation Service maintains a staff of biologists to advise soil conservation district cooperators and to encourage wildlife habitat development and improvement. The Agricultural Stabilization and Conservation Service provides subsidies for some wildlife habitat developments. The Bureau of Sport Fisheries and Wildlife, the Agricultural Extension Service, and others also encourage the preservation and development of wildlife habitat.

*Photo IV-2. This privately-developed pond is planted to corn or sudan grass each year to attract waterfowl. (Bureau of Sport Fisheries and Wildlife photo)*

# CONCLUSIONS

# CONCLUSIONS

Willamette Basin is blessed with a variety of habitat suitable for a wide range of fish and wildlife species. The widespread farmlands support ring-necked pheasants, valley and bobwhite quail, and fur animals in the farmed areas, and black-tailed deer, rabbits, grey squirrels, and mourning doves in the intermixed timber and woodland. Several species of waterfowl also are dependent on the farmlands for their feed. The timbered areas support black-tailed deer, black bear, elk, grouse, rabbits, band-tailed pigeons, and several fur animals.

The basin was once home to multitudes of waterbirds--ducks, geese, and swans, including trumpeter swans--but most of the marshlands have been drained, and waterfowl concentrations are now mostly confined to areas specifically managed for them.

There is a wide variety of fish, as well as wildlife, habitat in the basin. Most of the streams, lakes, and reservoirs are cold enough to support salmon, trout, and whitefish. Lower reaches of several streams also support warm-water game fish, as do lowland lakes and reservoirs. Mountain lakes in the high Cascades support native rainbow and cutthroat trout and introduced brook trout and brown trout. The cold-water streams, lakes, and reservoirs in Willamette Basin are generally not so productive of fish as comparable waters on the east side of the Cascade Range. Extensive stocking of trout is necessary to keep pace with the demand.

Salmon and steelhead trout from Columbia River and its tributaries are harvested in both sport and commercial fisheries extending over a wide area. The demand for these fish is steadily increasing, but the supply is in jeopardy because of, among other things, dams on the Columbia and Snake Rivers. Willamette River is the largest Columbia River tributary below the dams and has a tremendous potential for increasing supplies, particularly of fall chinook and coho salmon. This is because vast new spawning and rearing areas will become accessible when the fishway at Willamette Falls is completed. Previously, upstream passage over the falls was difficult except to limited numbers of steelhead trout and spring chinook.

Anadromous fish, in general, have suffered from water development projects since construction of the earliest dams, although this loss has not been so severe above Willamette Falls as elsewhere because of the scarcity of fish. Water development projects may also destroy habitat for big game, upland game, and fur animals and affect waterfowl habitat by reducing water inflow to lowland lakes and marshes. On the plus side, reservoirs have provided rearing areas for anadromous fish that have in instances increased spawning escapements 50 times. A large amount of sport fishing opportunity has been created on reservoirs. Cool water and water to dilute pollution have been furnished to downstream reaches; and several lowland reservoirs serve as duck-resting areas.

Consumptive uses of surface water, and the combined effects of domestic-industrial waste discharges and leaching of agricultural chemicals to flowing streams have degraded water quality over the years. From a fishery standpoint, those conditions have been most damaging in Portland Harbor, in the pool from Willamette Falls upstream to Newberg, and in the lower reaches of some tributaries.

In the mid-1960's the problem on the Willamette became so severe that lack of dissolved oxygen prevented downstream migration of juvenile anadromous fish and upstream migration of adults. The problem was particularly critical because attempts then were underway to establish, in the Basin, new runs of fall chinook and coho salmon.

Studies by Federal and State fishery and pollution control agencies showed that, short of shutting down industry to eliminate waste discharge, the only immediate solution would be to increase flows. Under those conditions, the Corps of Engineers, as a temporary emergency measure, made special releases from upstream storage reservoirs during late August and September. Those emergency releases, plus industry cooperation in temporarily reducing waste loadings prior to completion of additional treatment facilities, have made fish migration possible during the late 1960's.

For a permanent solution to the problem there is a need for additional action. This should include long-range pollution control programs, cancellation of unused water rights to prevent unauthorized future flow depletion, and provision of assured adequate minimum flows of good quality water. Adequate flow augmentation apparently can be assured only through additional authorizations for existing and/or potential new storage projects to be operated for that purpose.

Good water quality criteria for anadromous fish production could be described as: having temperature adjustments conducive to upstream migration, holding, spawning, egg incubation, fry emergence, juvenile rearing, and downstream migration; containing dissolved oxygen concentrations of 7 parts per million or greater; and meeting other water quality standards relating to dissolved nitrogen, pH, turbidity, noxious chemicals, pollutants, etc.

In recent years, general public reactions, and several new Federal laws, have to some extent changed the attitude of both Federal and private construction agencies toward fish and wildlife. It can now be assumed with some justification that under the Willamette Basin Comprehensive Plan, all losses to fish and wildlife will be mitigated. It may also be assumed that fish and wildlife resources associated with water development projects will be enhanced when it is economically feasible to do so. Enhancement opportunities are particularly promising downstream from proposed reservoirs where releases of water for the benefit of fish will also serve other project purposes such as water pollution control, navigation, and recreation.

In addition to dams, other factors have limited production of anadromous fish and, in some cases, resident fish as well. These include: (1) water pollution from industrial and domestic wastes and agricultural chemicals; (2) siltation from eroding farm and timberlands and from gravel mining and construction; (3) low summer flows, some natural, some caused by diversion of water for other uses; (4) unscreened diversions that trap fish, particularly downstream migrant salmonids; and (5) restricted or blocked fish passage at many natural obstacles. While not a problem at the present time, thermal pollution from nuclear powerplants may become the most serious limiting factor in the future. Continuous vigilance and control will be required to insure that these plants are properly sited and operated so as to avoid pollution of waters in the basin and in the Columbia River.

The limiting factors affecting wildlife populations, or use of wildlife, are closely related to land use. A large percentage of the wetlands that once made the basin a waterfowl paradise have been drained. High land prices and increased mechanization of farming have made possible intensive use of much agricultural land with associated destruction of habitat in previously uncultivated "waste" areas. Large areas of once-productive pheasant habitat have been converted to grassland for seed production and are burned annually. Pollution and water diversion have reduced wildlife populations in a few areas. Lack of public access to hunting areas, particularly for waterfowl and upland-game birds, is also a major problem.

To meet the minimum demand for anadromous fish for the year 2020, additional production of fish over the projected supply, as expressed in escapement to the spawning ground, will be 87,000 spring chinook, 72,000 fall chinook, 133,000 coho salmon, 42,000 winter steelhead, and 121,000 summer steelhead.

The methods that can be used to produce the additional anadromous fish to meet the demand are improved flows and temperatures below reservoirs (this may require reauthorization of present projects), fish passage at natural barriers, passage of fish at present dams where feasible, pond rearing with supplemental feeding, reservoir rearing, stream improvement, control of nongame fish in certain stream reaches and reservoirs, rearing of excess hatchery fish above natural obstructions, and production of fish in hatcheries.

Although stream trout habitat will be lost as a result of inundation by the reservoirs proposed for the basin, there will be an overall gain in habitat as a result of impoundment of cold water and improved streamflows. Since, however, little increase in production can be expected without stocking, most of the estimated 3,600,000 resident trout that will be needed in the 2020 catch must be supplied by artificial propagation. The 2020 need for an additional catch of 960,000 warm-water fish will be supplied by improved fisherman access to warm-water fishing areas, and by small reservoirs on the valley floor.

Since, in the future, habitat for most species of wildlife will decrease, and artificial propagation of most species is not feasible under present evaluation procedures, overall need for wildlife estimated at 2,631,500 days in 2020, cannot be met in total with the fish and wildlife plan presented in the Plan Formulation Appendix.

This plan consists of: (1) proposals associated with water development projects sponsored by the Corps of Engineers, the Bureau of Reclamation, and the Soil Conservation Service; and (2) projects and programs that are essentially single-purpose fish and wildlife enhancement proposals. Accomplishment of the latter will be the responsibility of the land-management agencies (U. S. Forest Service, and Bureau of Land Management), and of the fish and game agencies (Oregon State Game Commission, Fish Commission of Oregon, Bureau of Commercial Fisheries, and Bureau of Sport Fisheries and Wildlife). Many of these projects and programs will be cooperative efforts by two or more agencies.

Most of the developments proposed for the enhancement of fish and wildlife resources are programmed for the initial 10 to 15 year period. This is because demand for most species is already greater than supply and is increasing rapidly, and costs of development, particularly land costs, are rising even more rapidly.

Since costs of this program will be incurred over a relatively short period of time, it will be necessary for all agencies concerned to seek greatly expanded appropriations during the initial period. There will be little project-associated wildlife enhancement, so Oregon State Game Commission in particular will require funds far in excess of normal license fee receipts if needs for wildlife-associated recreational opportunity are to be satisfied to the degree indicated in this appendix.

The fish and wildlife plan for Willamette Basin, the estimated costs and benefits, and an analysis of the effects of the Comprehensive Plan on fish and wildlife are presented in Appendix M - Plan Formulation.

## RECOMMENDATIONS

In accordance with the basic objective of the Willamette Basin Comprehensive Plan, which are to provide for the best use or combination of uses of water and related land resources to meet all foreseeable short and long-term needs, the Fish and Wildlife Appendix Committee of Willamette Basin Task Force recommends that:

Land management and construction agencies actively cooperate with State and Federal fish and wildlife agencies throughout all phases of project planning, construction, and operation to insure that projects result in the maximum justifiable enhancement and the least possible damage to fish and wildlife resources and environmental quality.

When damage to fish and wildlife resources occurs as a result of project construction, or such damage is anticipated, construction agencies fund measures to compensate for such losses in accordance with Federal law.

Agencies administering public land undertake land posting and access development programs to insure that the public is afforded full opportunity to use its lands and waters for hunting and fishing and other outdoor recreation, except in areas reserved for safety, efficient operation, protection of public property, or conservation of fish and wildlife.

Fish and wildlife be a project purpose when new Willamette Basin dam and reservoir projects are authorized.

Existing dam and reservoir projects in the basin be reauthorized to include fish and wildlife as project purposes.

A hatchery-siting program be started in the near future in preparation for the large-scale hatchery construction program that will be necessary if demands for salmon and trout are to be met at the target dates.

Fish culture be expanded at a rate sufficient to meet otherwise unsatisfied needs at each target date.

Fish cultural methods supplemental to fish hatcheries or in conjunction with hatcheries be developed to more economically provide fish to satisfy future needs. Most promising development now is pond rearing of anadromous fish. Wahkeena Pond emptying into the Columbia River in Subbasin 11 has been used successfully to produce fall chinook and coho salmon. Technology has been perfected to such a degree that ponds at Salem and Stayton are rearing fish for downstream commercial and sport fishermen. Other ponds throughout the basin should be acquired to rear anadromous fish to meet future needs. Approximately 5 to 15 ponds of 2 to 20 surface acres each should be provided in the basin prior to 1980, another 10 to 20 ponds by 2000, and 10 to 20 more by 2020. These ponds, used in conjunction with the basin's fish cultural stations, would provide anadromous fish to meet 5 to 20 percent of the needs of commercial and sport fishermen at the target years.

Some reservoirs constructed or to be constructed within the basin be considered for rearing of anadromous fish exclusive of resident game fish. Within the concept of reservoir rearing, bottom outlets should be incorporated into the design of dams; and plans of operation should be established to completely drain the pools each year at the proper time to release the smolts into the streams below the projects.

Continuing fish management research programs be instituted, and funded at a level of $100,000 per year, to solve anadromous and sport fish production problems as they occur. The high cost of labor for hand-feeding salmon and trout in rearing ponds is one such current problem. Perfection of mechanical, time-controlled, refrigerated, fish feeding facilities could greatly decrease rearing costs in conventional ponds and could have wide application in reservoir and stream rearing of fish. Perfection of a dry pellet of proper nutritive value and palatability would eliminate the need for refrigeration in feeding facilities.

Land be acquired according to the Oregon State Game Commission's "Master Plans for Angler Access and Associated Recreational Uses." This program, already started, should be completed prior to 1980 to provide access for angiers to partially satisfy access needs through this first target date.

Municipal water supply watersheds closed to public access be opened to fishermen and hunters. The areas now closed (Bull Run near Portland, Haskins Creek near McMinnville, and Rickreall Reservoir near Dallas) are near population centers where there is also a great need for outdoor recreational areas. Opening these watersheds will satisfy partially access needs not provided for in the Oregon State Game Commission's Master Plan previously discussed.

The Willamette River Waterway public access plan be accomplished prior to 2000 to provide angler access to major stream areas of the Willamette system. This plan would satisfy stream access needs on the valley floor to 2020. There are lands adjacent to the Willamette River and some of its tributaries that have no designated owner. Those lands should be surveyed immediately and claimed by Oregon for fish and wildlife and general recreation purposes as part of the waterway system.

Special research and management programs be activated to control nongame fish within the existing reservoirs by 1980. As new reservoirs are impounded, they would be brought under this program. Presently, some reservoirs are so populated with nongame fish that the game fish are crowded out. Consequently, the reservoirs are used sparingly by fishermen.

High Cascade lakes and streams, accessible by trail and occasionally by road, be preserved for fishing and recreation to the exclusion of water storage projects, "pump-back" hydroelectric power projects, and other projects tending to reduce environmental quality.

Releases of adult and juvenile anadromous fish upstream from migration barriers be expanded to areas not now producing maximum numbers of fish. Such programs use fish which are excess to fish cultural stations capacities.

Fish and game conservation agencies assist and support the Federal Water Pollution Control Administration and the Oregon State Sanitary Authority in their efforts to improve water quality within the basin.

Construction agencies actively support and finance work on water quality predictions similar to the computerized reservoir model studies being conducted at Oregon State University for all reservoirs being contemplated for the Willamette Basin. Results of these studies will assist the fish and wildlife, recreation, and pollution control agencies in determining downstream flows and water quality so as to more ably evaluate the effects of the projects on these functions. These studies should have the highest priority and should be completed prior to 1980.

All water rights within the Willamette Basin be adjudicated and those found to be abandoned should be cancelled by the courts prior to 1980. Thereafter, water rights be reviewed periodically to cancel those that are abandoned.

The State of Oregon, through the State Water Resources Board and the State Engineer's Office, reserve all remaining natural flows in Willamette Basin streams for fish and wildlife. No more consumptive water rights be granted by the State Engineer where present rights indicate the streams are over-appropriated during low flow periods. Authorized consumptive water rights on many Willamette Basin streams permit withdrawal of water to the extent that remaining natural flows are well below the minimums established by the State Water Resources Board.

Studies be undertaken immediately to determine water flows for project streams that would be optimum for fish and wildlife production and also aid small boat navigation for fishermen, hunters, and other general recreationists.

Research programs be instituted to establish artificial stream-like channels to provide stream fishing areas near large population centers. Such areas be built to provide 100 miles of new fishing areas in each of the 3 subareas of the basin during each of the 3 time periods covered by this study. These channels would total 900 miles by 2020.

Small fishing impoundments be constructed near the population centers over the complete period of study until 2020. At least one pond be provided in each of the 3 subareas of the basin each 5 years. This would require that 6 be established by 1980, 12 more by 2000, and another 12 by 2020.

Landowners be encouraged and assisted to establish fish farms within the basin to provide commercial fish for the markets as well as pay-type fishing ponds for sport fishermen. These controlled ponds may even establish populations of commercially valuable species of fish that are rarely found in the Willamette Basin. These rearing areas would be licensed by the Oregon State Game Commission, under the laws of Oregon, to prevent the introduction of fish that would be detrimental to the important native and introduced species.

Physical access to stream areas on public lands be provided immediately by means of cleared stream-side trails and roads where possible. There are stream and lake areas near the larger population centers that are so brushy that people cannot walk through without extreme difficulty.

Allocations of 440 cfs of stored water be provided from Willamette Basin reservoirs to operate new upstream migrant facilities at Willamette Falls.

Research, investigation, and education programs be implemented to determine the preferences and reactions of the public to various wildlife management programs and to obtain support from sportsmen and landowners for development programs.

A computerized simulation of wildlife populations be established to predict and evaluate effects of habitat manipulation, harvest control, and other management techniques.

Approximately 2,500 acres of flood-plain land in each of Upper Willamette and Lower Willamette Subareas and 5,000 acres in Middle Willamette Subarea be acquired for fish and wildlife management purposes in cooperation with other land acquisition programs such as the Willamette River Park program and fisherman access programs of Oregon State Game Commission.

Acquisition or leasing and development of pigeon springs in the basin begin immediately or as funds are available. The 24 important areas should be acquired before 1980. See IV-28

Land be purchased and developed for waterfowl refuge and shooting ground combinations. Development would include fencing, access and construction, excavation, construction of blinds, and other features. About 2,000 acres would be added to Camas Swale GMA, 2,000 acres to Sauvie Island GMA, and a new 4,000 acre unit established in the Mid-Willamette Subarea. Acquisition of these areas should start as soon as money is made available.

Programs to provide upland game hunting on private farmland and timberland be started before 1980. This would include contracting with individual landowners to secure access for hunting on approximately 100,000 acres of farmland in each of the three subareas and about 1.5 million acres of private forest land in 16 localities in exchange for Oregon State Game Commission control of hunter distribution, trespass, and vandalism.

Water levels in Fern Ridge Reservoir be fluctuated as little as possible during the duck nesting season, approximately May 1 to July 1.

A system of dikes and canals to distribute water throughout marshlands associated with Fern Ridge Reservoir be constructed prior to 1980 or as soon thereafter as stabilized water levels are provided in the reservoir.

Thirty lowland lakes be acquired to furnish warm-water fishing, waterfowl hunting, and various other water-associated recreation. Acquisition and minimum development, such as fencing and access road construction, should commence as soon as funds are made available, but optimum development such as water control structures may not be necessary during the initial development period.

Acquisition of remaining land needed for the 3 units of W. L. Finley National Wildlife Refuge be completed as soon as funds are available, and development as planned be completed as soon as possible.

Approximately 2,100 acre-feet of water annually from storage in Long Tom watershed or elsewhere, be provided W. L. Finley National Wildlife Refuge to maintain optimum yields of wildlife foods and provide fall flooding of marsh areas for waterfowl.

The projects and programs for fish and wildlife enhancement on Bureau of Land Management and U. S. Forest Service administered lands be instituted substantially as indicated in Part IV of this appendix.

# ADDENDA

**Addendum A**

*Existing flows and their present or potential yield, and optimum flows with their additional potential yield, in terms of anadromous fish escapement. 1/*

| Stream | Stream Section or Measuring Point | Existing Summer Flows 2/ Monthly Mean (c.f.s.) | | | | Minimum Flow Required for Balance of Year 3/ | Present Potential Escapement | | | | | Optimum Flow (c.f.s.) & Resulting Additional Escapement 4/ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | July | August | Sept. | Oct. | | S. Chin. | F. Chin. | Coho | W. Sthd. | S. Sthd. | Year Around Optimum Flow | S. Chin. | F. Chin. | Coho | W. Sthd. | S. Sthd. |
| Willamette River | Mouth to Clackamas 5/ 6/ | N 9737 | 5747 | 3400 | 11825 | 6200 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | | S -- | 1059 | 2941 | 2239 | -- | -- | -- | -- | -- | -- | | | | | | |
| | Clackamas to Mill Cr. 5/ 6/ | N 7040 | 4826 | 4558 | 9752 | 6000 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | | S -- | 1059 | 2941 | 2239 | -- | -- | -- | -- | -- | -- | | | | | | |
| | Willamette Falls Fishway 6/ 7/ | 80 | 80 | 80 | 80 | | | | | | | 140 | -- | -- | -- | -- | -- |
| | Mill Cr. to McKenzie 5/ | N 4329 | 3079 | 3055 | 5313 | 4890 | -- | 10720 | -- | -- | -- | 4890 | -- | 17500 | -- | -- | -- |
| | | S 327 | 1273 | 1553 | 961 | -- | -- | 2080 | -- | -- | -- | | | | | | |
| | McKenzie to Forks 5/ | N 1527 | 1042 | 1063 | 2312 | 2000 | -- | 923 | -- | -- | -- | 2500 | -- | 2300 | -- | -- | -- |
| | | S 508 | 1298 | 1606 | 1599 | -- | -- | 777 | -- | -- | -- | | | | | | |
| Subbasin 1 Coast Fork Willamette | Mouth to Row River (USGS gage 14-1575) 5/ | N 186 | 111 | 93 | 534 | 200 | -- | 1260 | 250 | 200 | -- | 450 | 3700 | 700 | -- | 1000 | -- |
| | | S 256 | 738 | 245 | 35 | -- | -- | 1740 | -- | -- | -- | | | | | | |
| | Row R. to Cottage Grove Dam (USGS gage 14-1535) 5/ | N 42 | 21 | 22 | 87 | 125 | -- | 286 | 10 | 90 | -- | 125 | 650 | 150 | -- | 200 | -- |
| | | S 15 | 221 | 187 | 66 | -- | -- | 814 | -- | 210 | -- | | | | | | |
| Row River | Mouth to Dorena Dam (USGS gage 14-1555) 5/ | N 78 | 49 | 41 | 267 | 190 | -- | 330 | -- | 165 | -- | 190 | 900 | -- | -- | 400 | -- |
| | | S 299 | 561 | 125 | 34 | -- | -- | 670 | -- | 335 | -- | | | | | | |
| Mosby Cr. | Mouth to Fall Cr. (USGS gage 14-1565) 8/ | 24 | 12 | 11 | 68 | 90 | -- | -- | -- | -- | - | 90 | 550 | 350 | 700 | 1000 | -- |
| | Fall Cr. upstream | No measurements | | | | 90 | -- | -- | 450 | 450 | -- | 90 | -- | -- | 250 | 250 | -- |
| Subbasin 2 Middle Fork Willamette | Mouth to Dexter (USGS gage 14-1520) 5/ | N 1243 | 862 | 803 | 1349 | 2115 | 2540 | 4575 | -- | 178 | 178 | 2115 | 1000 | -- | -- | 300 | 300 |
| | | S 171 | 535 | 1364 | 2054 | -- | 2460 | 4425 | -- | 172 | 172 | | | | | | |
| | Head Lookout Pt. Res. 5/ to mouth N.Fk. of M.Fk. (USGS gage 14-1480) 5/ | 1236 | 872 | 806 | 1275 | 1200 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Fall Cr. | Mouth to dam (USGS gage 14-1510) 5/ | 99 | 52 | 59 | 299 | 150 | -- | 250 | -- | 250 | 250 | 320 | 500 | 1000 | -- | -- | 500 |
| | Above Fall Cr. Res. (USGS gage 14-1503) 9/ | 60 | 37 | 32 | 51 | 125 | 150 | -- | -- | 800 | 800 | 125 | -- | -- | -- | -- | -- |

Addendum A (continued)

| Stream | Stream Section or Measuring Point | Existing Summer Flows 2/ Monthly Mean (c.f.s.) July | August | Sept. | Oct. | Minimum Flow Required for Balance of Year 3/ | Present Potential Escapement S. Chin. | F. Chin. | Coho | W. Sthd. | S. Sthd. | Optimum Flow (c.f.s.) & Resulting Additional Escapement 4/ Year Around Optimum Flow | S. Chin. | F. Chin. | Coho | W. Sthd. | S. Sthd. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Little Fall Cr. | (Mouth) 10/ | 26 | 20 | 14 | 24 | 80 | -- | -- | 1000 | 400 | 400 | -- | -- | -- | -- | -- | -- |
| Winberry Cr. | Mouth (USGS gage 14-1508) 9/ | 19 | 11 | 8 | 14 | 50 | -- | -- | 300 | 350 | -- | -- | -- | -- | -- | -- | -- |
| North Fork Winberry | (Mouth) 10/ | 7 | 5 | 3 | 5 | 25 | -- | -- | 100 | 100 | -- | -- | -- | -- | -- | -- | -- |
| South Fork Winberry | (Mouth) 10/ | 6 | 4 | 3 | 5 | 40 | -- | -- | 350 | 350 | -- | -- | -- | -- | -- | -- | -- |
| N.Fk. Fall Cr. | (Mouth) 10/ | 4 | 3 | 2 | 7 | 15 | -- | -- | 50 | 80 | -- | -- | -- | -- | -- | -- | -- |
| Portland Cr. | (Mouth) 10/ | 9 | 7 | 4 | 9 | 50 | -- | -- | 100 | 150 | -- | -- | -- | -- | -- | -- | -- |
| Alder Cr. | (Mouth) 10/ | 4 | 3 | 2 | 3 | 15 | -- | -- | 30 | 50 | -- | -- | -- | -- | -- | -- | -- |
| Hehe Cr. | (Mouth) 10/ | 6 | 5 | 4 | 6 | 35 | -- | -- | 300 | 200 | -- | -- | -- | -- | -- | -- | -- |
| Lost Cr. | Mouth to Guiley Cr. 10/ | 7 | 4 | 2 | 7 | 50 | -- | -- | 450 | 300 | -- | -- | -- | -- | -- | -- | -- |
| | (Above Guiley Cr.) 10/ | 3 | 2 | 0.7 | 4 | 18 | -- | -- | 150 | 150 | -- | -- | -- | -- | -- | -- | -- |
| Guiley Cr. | (Mouth) 10/ | 2 | 1 | 0.4 | 2 | 15 | -- | -- | 50 | 40 | -- | -- | -- | -- | -- | -- | -- |
| North Fork Willamette | Mouth to Plateau Cr. (USGS gage 14-1475) 8/ | 284 | 181 | 159 | 268 | 200 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Subbasin 3 McKenzie R. | Mouth to Walterville outlet (USGS gage 14-1655) 5/ | 2646 | 2117 | 2039 | 2837 | 2000 | 4600 | 2900 | -- | -- | 950 | 2000 | -- | -- | -- | -- | -- |
| | Walterville outlet to Walterville inlet 11/ 12/ | 771 | 508 | 473 | 1017 | 2000 | 1800 | 850 | -- | -- | 300 | 2000 | -- | -- | -- | -- | -- |
| | Walterville inlet to Leaburg outlet 5/ | 2488 | 2057 | 1951 | 2663 | 2000 | 900 | 800 | -- | -- | 250 | 2000 | -- | -- | -- | -- | -- |
| | Leaburg outlet to Leaburg Dam 11/ 13/ | 383 | 636 | 611 | 1183 | 2000 | 1300 | 900 | -- | -- | 300 | 2000 | -- | -- | -- | -- | -- |
| | Leaburg Dam to Gate Cr. (USGS gage 14-1625) 5/ | 2488 | 2057 | 1951 | 2663 | 2000 | 650 | 450 | -- | -- | 150 | 2000 | -- | -- | -- | -- | -- |
| | Gate Cr. to Blue River (USGS gage 14-1625) 5/ | 2445 | 2028 | 1930 | 2526 | 2000 | 3500 | 2300 | 10 | -- | 700 | 2000 | -- | -- | -- | -- | -- |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| McKenzie R. (cont.) | Blue River to South Fk. (USGS gage 14-1625) 5/ | 1988 | 1890 | 1770 | 2060 | 2000 | 650 | 450 | -- | -- | 150 | 2000 | -- | -- | -- | -- | -- |
| | South Fk. to Horse Cr. (USGS gage 14-1590) 5/ | 1655 | 1624 | 1511 | 1643 | 1200 | 1300 | 900 | 40 | -- | 300 | 1200 | -- | -- | -- | -- | -- |
| | Horse Cr. upstream (USGS gage 14-1590) 5/ | 1223 | 1288 | 1196 | 1308 | 750 | 3500 | 2500 | -- | -- | 800 | 750 | -- | -- | -- | -- | -- |
| Mohawk R. | Mouth to McGowan Cr. (USGS gage 14-1650) 5/ | 54 | 31 | 27 | 50 | 200 | -- | 100 | -- | -- | -- | 200 | -- | 300 | 250 | 100 | -- |
| | McGowan Cr. to Cartwright Cr. 14/ | 53 | 30 | 26 | 49 | 200 | -- | 150 | -- | 150 | -- | 200 | -- | 650 | 450 | 70 | -- |
| | Cartwright Cr. to Mill Cr. 14/ | 50 | 28 | 25 | 46 | 170 | -- | 60 | -- | 50 | -- | 170 | -- | 350 | 150 | 60 | -- |
| | Mill Cr. to Shotgun Cr. 10/ | 26 | 21 | 9 | 14 | 120 | -- | 90 | 100 | 80 | -- | 120 | -- | 300 | 100 | 30 | -- |
| | Shotgun Cr. to Forks (Mile 21) 10/ | 22 | 17 | 8 | 11 | 80 | -- | 200 | 700 | 550 | -- | 80 | -- | -- | 550 | 200 | -- |
| McGowan Cr. | (Mouth) 10/ | 1 | 0.5 | 0.3 | 0.8 | 17 | -- | -- | 100 | 80 | -- | -- | -- | -- | -- | -- | -- |
| Parsons Cr. | (Mouth) 10/ | 0.9 | 1 | 0.1 | 1.6 | 25 | -- | -- | 150 | 100 | -- | -- | -- | -- | -- | -- | -- |
| Cartwright Cr. | (Mouth) 10/ | 2 | 1 | 0.5 | 1 | 12 | -- | -- | 200 | 100 | -- | -- | -- | -- | -- | -- | -- |
| Mill Cr. | (Mouth) 10/ | 7 | 4 | 3 | 3 | 50 | -- | -- | 700 | 450 | -- | -- | -- | -- | -- | -- | -- |
| Cash Cr. | (Mouth) 10/ | 1 | 0.7 | 0.6 | 0.6 | 15 | -- | -- | 150 | 100 | -- | -- | -- | -- | -- | -- | -- |
| Shotgun Cr. | (Mouth) 10/ | 4 | 4 | 2 | 3 | 25 | -- | -- | 450 | 350 | -- | -- | -- | -- | -- | -- | -- |
| Drury Cr. | (Mouth) 10/ | 1 | 0.6 | 0.5 | 0.5 | 8 | -- | -- | 70 | 40 | -- | -- | -- | -- | -- | -- | -- |
| Camp Cr. | (Mouth) 10/ | 2 | 0.8 | 0.3 | 3.5 | 30 | -- | -- | 250 | 150 | -- | -- | -- | -- | -- | -- | -- |
| Holden Cr. | (Mouth) 10/ | 2 | 2 | 0.4 | 1.2 | 12 | -- | -- | 20 | -- | -- | -- | -- | -- | -- | -- | -- |
| Gate Cr. | Mouth (USGS gage 14-1630) 9/ | 43 | 29 | 21 | 137 | 80 | 150 | -- | 300 | -- | 150 | -- | -- | -- | -- | -- | -- |
| N.Fk. Gate | (Mouth) 10/ | 19 | 15 | 12 | 11 | 40 | -- | -- | 600 | -- | 450 | -- | -- | -- | -- | -- | -- |
| S.Fk. Gate | (Mouth) 10/ | 10 | 10 | 8 | 7 | 35 | -- | -- | 450 | -- | 200 | -- | -- | -- | -- | -- | -- |
| Marten Cr. | (Mouth) 10/ | 10 | 10 | 5 | 4 | 30 | -- | -- | 150 | 150 | -- | -- | -- | -- | -- | -- | -- |
| Deer Cr. (lower) | (Mouth) 10/ | 9 | 9 | 5 | 6 | 40 | -- | -- | 400 | 250 | -- | -- | -- | -- | -- | -- | -- |

Addendum A (continued)

| Stream | Stream Section or Measuring Point | Existing Summer Flows 2/ Monthly Mean (c.f.s.) July | August | Sept. | Oct. | Minimum Flow Required for Balance of Year 3/ | Present Potential Escapement. S. Chin. | F. Chin. | Coho | W. Sthd. | S. Sthd. | Optimum Flow (c.f.s.) & Resulting Additional Escapement 4/ Year Around Optimum Flow | S. Chin. | F. Chin. | Coho | W. Sthd. | S. Sthd. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ennis Cr. | (Mouth) 10/ | 4 | 3 | 2 | 3 | 18 | -- | -- | 350 | 200 | -- | -- | -- | -- | -- | -- | -- |
| Quartz Cr. | (Mouth) 10/ | 5 | 3 | 3 | 2 | 60 | -- | -- | 800 | 550 | -- | -- | -- | -- | -- | -- | -- |
| Blue River | (Mouth) 14/ | 56 | 34 | 44 | 165 | 380 | -- | -- | 40 | -- | -- | -- | -- | -- | -- | -- | -- |
| Simmons Cr. | (Mouth) 10/ | 1 | 2 | 0.4 | 0.8 | 15 | -- | -- | 30 | 20 | -- | -- | -- | -- | -- | -- | -- |
| South Fork McKenzie | Below Cougar Dam 5/ (USGS gage 14-1595) | 533 | 266 | 259 | 417 | 400 | 450 | -- | -- | 30 | 150 | -- | -- | -- | -- | -- | -- |
| Elk Cr. | (Mouth) 10/ | 19 | 18 | 12 | 16 | 50 | -- | -- | -- | 150 | -- | -- | -- | -- | -- | -- | -- |
| Horse Cr. | Mouth to Avenue Cr. (USGS gage 14-1591) 8/ | 432 | 336 | 315 | 335 | 300 | 400 | 900 | -- | -- | 400 | 300 | -- | -- | -- | -- | -- |
| | Ave. Cr. to Separation Cr. | No measurements | | | | 300 | 350 | 750 | -- | -- | 800 | 300 | -- | -- | -- | -- | -- |
| Lost Cr. | (Mouth) 10/ | 275 | 250 | 250 | 225 | 150 | 150 | 350 | -- | -- | 300 | -- | -- | -- | -- | -- | -- |
| Scott Cr. | (Mouth) 10/ | 8 | 4 | 3 | 5 | 20 | -- | -- | 40 | -- | -- | -- | -- | -- | -- | -- | -- |
| Deer Cr. (upper) | (Mouth) 10/ | 26 | 15 | 10 | 14 | 80 | -- | -- | 60 | 200 | -- | -- | -- | -- | -- | -- | -- |
| Olallie Cr. | (Mouth) 10/ | 130 | 125 | 125 | 125 | 100 | -- | -- | -- | 10 | -- | -- | -- | -- | -- | -- | -- |
| Subbasin 4 Long Tom R. | Mouth to Fernridge Dam (USGS gage 14-1700) 5/ | N 49<br>S -- | 54<br>56 | 46<br>423 | 120<br>378 | 25 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | (USGS gage 14-1690) 5/ | N 44<br>S -- | 58<br>56 | 34<br>423 | 75<br>378 | 30 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | Head Fernridge Res. to Gold Run Cr. 8/ (USGS gage 14-1665) | 29 | 16 | 17 | 37 | 75 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Ferguson Cr. | (3 miles above mouth) | 2 | 0.7 | 0.6 | 1 | 20 | -- | -- | 150 | 90 | -- | -- | -- | -- | -- | -- | -- |
| Bear Cr. | (1 mile above mouth) 10/ | 0.2 | 0.1 | 0.1 | 0.2 | 8 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Subbasin 5 Santiam R. | Mouth to Forks (USGS gage 14-1890) 5/ | N 1362<br>S 143 | 669<br>269 | 1148<br>978 | 4273<br>1545 | 1900 | --<br>-- | 1220<br>480 | --<br>-- | --<br>-- | --<br>-- | 1900 | 4300 | 350 | -- | -- | 1200 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N. Santiam R. | Mouth to L.N. Santiam (USGS gage 14-1830) 5/ | N 1201<br>S 143 | 841<br>269 | 1011<br>978 | 2252<br>1545 | 1200 | 515<br>285 | 11400<br>6300 | 90<br>-- | 97<br>53 | 97<br>53 | 1200 | 6200 | -- | -- | 1100 | 1100 |
| | L. N. Santiam upstream 5/ | N 1086<br>S 143 | 780<br>269 | 894<br>978 | 1770<br>1545 | 1200 | 1520<br>980 | 5520<br>3580 | -- | 152<br>98 | 152<br>98 | 1200 | 3600 | -- | -- | 200 | 400 |
| Stout Cr. | (Mouth) 10/ | 5 | 2 | 3 | 19 | 20 | -- | -- | 400 | 200 | -- | -- | -- | -- | -- | -- | -- |
| L.N. Santiam | Mouth (USGS gage 14-1825) 8/ | 115 | 61 | 117 | 482 | 180 | 800 | 2600 | -- | 550 | 200 | 350 | 2000 | 600 | -- | 250 | 250 |
| Elkhorn | (Mouth) 10/ | 18 | 4 | 7 | 37 | 50 | -- | -- | 150 | 150 | -- | -- | -- | -- | -- | -- | -- |
| Rock Cr. | (Mouth) 10/ | 4 | 2 | 3 | 16 | 50 | -- | -- | 400 | 200 | -- | -- | -- | -- | -- | -- | -- |
| Mad Cr. | (Mouth) 10/ | 1 | 0.4 | 0.7 | 4 | 25 | -- | -- | 20 | 20 | -- | -- | -- | -- | -- | -- | -- |
| S. Santiam | Mouth to Waterloo 14/ | 627 | 356 | 479 | 1899 | 500 | -- | 11100 | -- | -- | -- | */ | 4700 | 2200 | -- | -- | 1300 |
| | Waterloo to Foster Dam 8/ | 488 | 266 | 401 | 1641 | 500 | -- | 8600 | -- | -- | -- | */ | 3600 | 1500 | -- | -- | 1000 |
| | Foster Res. to Cascadia (USGS gage 14-1850) 8/ | 153 | 74 | 115 | 451 | 90 | 500 | -- | -- | 400 | -- | 90 | 150 | -- | -- | 350 | 350 |
| | Cascadia to Trout Cr. 8/ | 153 | 74 | 115 | 451 | 70 | 984 | -- | 1100 | 800 | -- | 70 | 400 | -- | 400 | 800 | 800 |
| | Trout Cr. upstream 14/ | 116 | 53 | 93 | 414 | 70 | 500 | -- | 850 | 350 | -- | 70 | 150 | -- | 300 | 350 | 350 |
| Thomas Cr. | Mouth to Jordan Cr. (USGS gage 14-1888) 9/ | 63 | 43 | 39 | 163 | 100 | -- | 1000 | 350 | -- | -- | 215 | 1500 | 1900 | -- | -- | 2300 |
| | Jordan Cr. upstream 14/ | 50 | 36 | 32 | 134 | 90 | 150 | 600 | -- | 1200 | -- | 90 | 1300 | 60 | 350 | -- | 950 |
| Neal Cr. | (Mouth) 10/ | 13 | 7 | 7 | 29 | 60 | -- | -- | 166 | 318 | -- | -- | -- | -- | -- | -- | -- |
| Jordan Cr. | (Mouth) 10/ | 0.1 | 0 | 0 | 0.2 | 25 | -- | -- | 40 | 20 | -- | -- | -- | -- | -- | -- | -- |
| Crabtree Cr. | Mouth to Roaring R. (USGS gage 14-1887) 9/ | 76 | 47 | 39 | 95 | 100 | 250 | 650 | 250 | 650 | -- | 185 | 1200 | 1600 | 100 | -- | 550 |
| | Roaring R. upstream 14/ | 52 | 34 | 22 | 66 | 110 | 80 | 500 | 200 | 850 | -- | 110 | 850 | 20 | 150 | -- | 350 |

*/ Amount and temperature of water needed to be released for fish from Foster Reservoir to provide optimum environmental conditions in the South Santiam River.

| Month | Flow (cfs) | Temperature (°F) |
|---|---|---|
| January-April | 850 | 50 |
| May-June | 850 | 55 |
| July | 1,100 | 45 |
| August | 1,000 | 45 |
| September | 900 | 50 |
| October-December | 850 | 50 |

Addendum A (continued)

| Stream | Stream Section or Measuring Point | Existing Summer Flows 2/ Monthly Mean (c.f.s.) | | | | Minimum Flow Required for Balance of Year 3/ | Present Potential Escapement | | | | | Optimum Flow (c.f.s.) & Resulting Additional Escapement 4/ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | July | August | Sept. | Oct. | | S. Chin. | F. Chin. | Coho | W. Sthd. | S. Sthd. | Year Around Optimum Flow | S. Chin. | F. Chin. | Coho | W. Sthd. | S. Sthd. |
| Hamilton | (Mouth) 10/ | 11 | 6 | 4 | 37 | 40 | -- | -- | 400 | 350 | -- | -- | -- | -- | -- | -- | -- |
| Scott Cr. | Mouth to S.F. Scott Cr. 10/ | 6 | 3 | 3 | 20 | 14 | -- | -- | 80 | 40 | -- | -- | -- | -- | -- | -- | -- |
| S.F. Scott | (Mouth) 10/ | 4 | 2 | 2 | 14 | 19 | -- | -- | -- | 30 | -- | -- | -- | -- | -- | -- | -- |
| McDowell | (Mouth) 10/ | 11 | 4 | 3 | 20 | 45 | -- | -- | 550 | 300 | -- | -- | -- | -- | -- | -- | -- |
| Wiley Cr. | Mouth (USGS gage 14-1870) 8/ | 35 | 16 | 19 | 77 | 110 | 150 | -- | 350 | 800 | -- | 110 | 100 | -- | 300 | 500 | -- |
| L. Wiley | (Mouth) 10/ | 10 | 6 | 4 | 23 | 30 | -- | -- | 150 | -- | -- | -- | -- | -- | -- | -- | -- |
| M. Santiam | Mouth to Green Peter Dam (USGS gage 14-1865) 8/ | 280 | 163 | 197 | 805 | 150 | -- | -- | -- | 100 | 100 | 150 | 200 | -- | -- | 200 | 150 |
| | Head Green Peter Res. 9/ to Bear Cr (USGS gage 14-1858) | 149 | 84 | 62 | 117 | 150 | 800 | -- | -- | 300 | 300 | 150 | 450 | -- | -- | 550 | 250 |
| | Bear Cr. upstream 14/ | 133 | 75 | 55 | 101 | 100 | 800 | -- | 200 | 850 | 350 | 100 | 1100 | -- | -- | 750 | 750 |
| Whitcomb | (Mouth) 10/ | 7 | 4 | 3 | 7 | 55 | -- | -- | 50 | 50 | -- | -- | -- | -- | -- | -- | -- |
| Quartzville | Mouth to Canal Cr. (USGS gage 14-1859) 9/ | 143 | 72 | 54 | 166 | 90 | 850 | -- | 200 | 350 | 300 | 90 | 250 | -- | 150 | 250 | 250 |
| | Canal Cr. upstream 10/ | 17 | 13 | 12 | 26 | 70 | 800 | -- | 400 | 300 | 300 | 70 | 250 | -- | 300 | 300 | 300 |
| Moose | (Mouth) 10/ | 7 | 3 | 3 | 7 | 18 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Canal | Mouth to Elk Cr. 10/ | 19 | 6 | 7 | 15 | 60 | -- | -- | 400 | 200 | -- | -- | -- | -- | -- | -- | -- |
| | Elk Cr. upstream 10/ | 7 | 3 | 3 | 6 | 30 | -- | -- | -- | 50 | -- | -- | -- | -- | -- | -- | -- |
| Elk Cr. | (Mouth) 10/ | 4 | 2 | 2 | 4 | 50 | -- | -- | 30 | 40 | -- | -- | -- | -- | -- | -- | -- |
| Rumbaugh | (Mouth) 10/ | 3 | 1 | 1 | 3 | 25 | -- | -- | 40 | 10 | -- | -- | -- | -- | -- | -- | -- |
| Tally Cr. | (Mouth) 10/ | 12 | 5 | 5 | 11 | 35 | -- | -- | 100 | 100 | -- | -- | -- | -- | -- | -- | -- |
| Bear Cr. | (Mouth) 10/ | 16 | 9 | 7 | 16 | 25 | -- | -- | 70 | 60 | -- | -- | -- | -- | -- | -- | -- |
| Canyon Cr. | Mouth to 0.5 mile below Owl Cr. 10/ | 25 | 14 | 15 | 25 | 75 | -- | -- | 550 | 200 | 200 | -- | -- | -- | -- | -- | -- |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Canyon Cr. (cont.) | 0.5 mile below Owl Cr. upstream 10/ | 16 | 9 | 8 | 16 | 65 | -- | -- | 350 | 150 | 150 | -- | -- | -- | -- | -- | -- |
| Owl Cr. | (Mouth) 10/ | 5 | 3 | 4 | 5 | 40 | -- | -- | 200 | 90 | 50 | -- | -- | -- | -- | -- | -- |
| Boundry | (Mouth) 10/ | 1 | 0.7 | 0.6 | 1 | 20 | -- | -- | 10 | 10 | -- | -- | -- | -- | -- | -- | -- |
| Soda Fork | (Mouth) 10/ | 9 | 5 | 4 | 9 | 60 | -- | -- | 150 | 250 | -- | -- | -- | -- | -- | -- | -- |
| Calapooia R. | Mouth to Holley (USGS gage 14-1735) 8/ | 78 | 39 | 44 | 171 | 160 | -- | 1300 | 400 | -- | -- | 250 | 1200 | 1800 | - | 2000 | -- |
| | Holley upstream (USGS gage 14-1720) 8/ | 70 | 41 | 44 | 151 | 140 | -- | 1200 | 600 | 750 | -- | 140 | 1800 | 150 | 250 | 2600 | -- |
| Brush Cr. | (Mouth) 10/ | 5 | 3 | 3 | 15 | 35 | -- | -- | 400 | 150 | -- | -- | -- | -- | -- | -- | -- |
| Subbasin 6 Yamhill R. | Mouth to Forks 8/ | 128 | 69 | 108 | 505 | 90 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| S. Yamhill | Mouth to 2.5 miles below Deer Cr. 8/ | 94 | 49 | 88 | 417 | 70 | -- | -- | 150 | 100 | -- | -- | -- | -- | -- | -- | -- |
| | 2.5 miles below Deer Cr. to Willamina Cr. 8/ | 94 | 49 | 88 | 417 | 200 | -- | 700 | 400 | 300 | -- | 225 | -- | 950 | 3600 | 1500 | -- |
| | Willamina Cr. to Rock Cr. 8/ | 41 | 25 | 50 | 217 | 150 | -- | 150 | 150 | 60 | -- | 150 | -- | 200 | 700 | 500 | -- |
| | Rock Cr. upstream 14/ | 29 | 20 | 41 | 165 | 70 | -- | 100 | 850 | 550 | -- | 70 | -- | 60 | 550 | 400 | -- |
| Mill Cr. | Mouth 8/ | 11 | 7 | 11 | 80 | 80 | -- | 350 | 950 | 1300 | -- | 80 | -- | 300 | 500 | 500 | -- |
| Gooseneck | Mouth 10/ | 1 | 0.5 | 0.5 | 3 | 10 | -- | -- | 200 | 200 | -- | -- | -- | -- | -- | -- | -- |
| Willamina | Mouth 8/ | 32 | 21 | 23 | 74 | 70 | -- | 150 | 700 | 250 | 300 | 70 | -- | 200 | 450 | 60 | 100 |
| Coast Cr. | Mouth 10/ | 4 | 2 | 3 | 11 | 45 | -- | -- | 550 | 200 | 200 | -- | -- | -- | -- | -- | -- |
| Canada | Mouth 10/ | 3 | 2 | 2 | 8 | 20 | -- | -- | 90 | 100 | -- | -- | -- | -- | -- | -- | -- |
| Burton | Mouth 10/ | 1 | 0.7 | 0.9 | 4 | 10 | -- | -- | 50 | 40 | -- | -- | -- | -- | -- | -- | -- |
| E. Fork Willamina | Mouth 10/ | 11 | 7 | 8 | 32 | 30 | -- | -- | 700 | 300 | -- | -- | -- | -- | -- | -- | -- |
| Gold Cr. | Mouth 10/ | 2 | 0.8 | 2 | 9 | 25 | -- | -- | 200 | 100 | -- | -- | -- | -- | -- | -- | -- |
| Cosper Cr. | Mouth 10/ | 2 | 0.7 | 1 | 8 | 25 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Rowell Cr. | Mouth 10/ | 8 | 3 | 6 | 35 | 45 | -- | -- | 500 | 300 | -- | -- | -- | -- | -- | -- | -- |
| Rock Cr. | Mouth 10/ | 25 | 11 | 11 | 62 | 70 | -- | 70 | 200 | 300 | -- | 70 | -- | 90 | 350 | 350 | -- |

Addendum A (continued)

| Stream | Stream Section or Measuring Point | Existing Summer Flows 2/ Monthly Mean (c.f.s.) | | | | Minimum Flow Required for Balance of Year 3/ | Present Potential Escapement | | | | | Optimum Flow (c.f.s.) & Resulting Additional Escapement 4/ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | July | August | Sept. | Oct. | | S. Chin. | F. Chin. | Coho | W. Sthd. | S. Sthd. | Year Around Optimum Flow | S. Chin. | F. Chin. | Coho | W. Sthd. | S. Sthd. |
| Rock Cr. (cont.) | | | | | | | | | | | | | | | | | |
| Cow Cr. | Mouth | No measurements | | | | 10 | -- | -- | 10 | -- | -- | -- | -- | -- | -- | -- | -- |
| Joe Day | Mouth | No measurements | | | | 7 | -- | -- | 90 | 60 | -- | -- | -- | -- | -- | -- | -- |
| Rogue R. | Mouth 10/ | 5 | 1 | 1 | 7 | 35 | -- | -- | 350 | 200 | -- | -- | -- | -- | -- | -- | -- |
| Agency Cr. | Mouth 10/ | 20 | 6 | 6 | 34 | 80 | -- | -- | 850 | 500 | -- | -- | -- | -- | -- | -- | -- |
| Wind R. | Mouth 10/ | 1 | 0.5 | 0.5 | 2.8 | 10 | -- | -- | -- | 50 | -- | -- | -- | -- | -- | -- | -- |
| Ead Cr. | Mouth 10/ | 9 | 4 | 3 | 14 | 25 | -- | -- | 100 | 80 | -- | -- | -- | -- | -- | -- | -- |
| Pierce Cr. | Mouth 10/ | 2 | 1 | 0.7 | 4 | 12 | -- | -- | 40 | 30 | -- | -- | -- | -- | -- | -- | -- |
| Kitten Cr. | Mouth 10/ | 1 | 0.6 | 0.3 | 2 | 16 | -- | -- | 20 | -- | -- | -- | -- | -- | -- | -- | -- |
| Hanchet | Mouth 10/ | 0.9 | 0.4 | 0.2 | 1 | 11 | -- | -- | 20 | -- | -- | -- | -- | -- | -- | -- | -- |
| N. Yamhill R. | Mouth to Pike 14/ | 34 | 20 | 20 | 88 | 70 | -- | -- | 650 | 400 | -- | 70 | -- | 200 | 550 | 350 | -- |
| | Pike upstream 14/ | 14 | 9 | 12 | 29 | 70 | -- | -- | 1100 | 600 | -- | -- | -- | -- | -- | -- | -- |
| Baker Cr. | 3 miles above mouth 10/ | 10 | 6 | 4 | 29 | 30 | -- | -- | 80 | 150 | -- | -- | -- | -- | -- | -- | -- |
| Panther | Below Kane Cr. 10/ | 4 | 2 | 3 | 12 | 25 | -- | -- | 250 | 200 | -- | -- | -- | -- | -- | -- | -- |
| Turner Cr. | Mouth 10/ | 6 | 3 | 1 | 18 | 25 | -- | -- | 200 | 100 | -- | -- | -- | -- | -- | -- | -- |
| Cedar Cr. | Mouth 10/ | 3 | 1 | 2 | 7 | 12 | -- | -- | 30 | 30 | -- | -- | -- | -- | -- | -- | -- |
| Haskins | Mouth 8/ | 7 | 5 | 4 | 8 | 25 | -- | -- | 40 | 40 | -- | -- | -- | -- | -- | -- | -- |
| Fairchild | Mouth 10/ | 9 | 3 | 3 | 26 | 25 | -- | -- | 150 | 100 | -- | -- | -- | -- | -- | -- | -- |
| Rickreall Cr. | Mouth 8/ | 8 | 4 | 7 | 44 | 80 | -- | -- | 500 | 400 | -- | 80 | -- | 600 | 1900 | 1500 | -- |
| Luckiamute R. | Mouth to Pedee Cr. 8/ | 66 | 36 | 51 | 184 | 200 | -- | 100 | 100 | -- | -- | 200 | -- | 70 | 500 | 600 | -- |
| | Pedee to Haskins 8/ | 40 | 23 | 29 | 105 | 200 | -- | 250 | 40 | -- | -- | 200 | -- | 150 | 500 | 600 | -- |
| | Haskins upstream 8/ | 22 | 14 | 20 | 73 | 120 | -- | 200 | 1200 | 1000 | -- | 120 | -- | 80 | 1400 | 1300 | -- |
| L.Luckiamute | River mile 5 10/ | 21 | 13 | 19 | 23 | 80 | -- | 100 | 350 | 200 | -- | 80 | -- | 70 | 300 | 200 | 200 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pedee Cr. | Mouth 10/ | 6 | 4 | 5 | 22 | 25 | -- | -- | 250 | 150 | -- | -- | -- | -- | -- | -- | -- |
| N. F. Pedee | Mouth 10/ | 6 | 3 | 4 | 20 | 35 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| S. F. Pedee | Mouth 10/ | 0.6 | 0.4 | 0.3 | 1 | 6 | -- | -- | 20 | 20 | -- | -- | -- | -- | -- | -- | -- |
| Ritner Cr. | Mouth 10/ | 12 | 2 | 1 | 6 | 45 | -- | -- | 400 | 250 | -- | -- | -- | -- | -- | -- | -- |
| Clayton | Mouth 10/ | 0.5 | 0.3 | 0.4 | 2 | 8 | -- | -- | 20 | -- | -- | -- | -- | -- | -- | -- | -- |
| Sheythe | Mouth 10/ | 0.8 | 0.5 | 0.5 | 2 | 13 | -- | -- | 40 | -- | -- | -- | -- | -- | -- | -- | -- |
| Maxfield | Mouth 10/ | 0.1 | 0 | 0.1 | 0.5 | 12 | -- | -- | 70 | 80 | -- | -- | -- | -- | -- | -- | -- |
| Price Cr. | Mouth 10/ | 0.5 | 0.3 | 0.6 | 2.8 | 25 | -- | -- | 150 | -- | -- | -- | -- | -- | -- | -- | -- |
| Marys R. | Mouth to 2 miles below Tumtum R. 8/ | 30 | 15 | 17 | 57 | 135 | -- | -- | 850 | 450 | -- | -- | -- | -- | -- | -- | -- |
| | 2 miles below Tumtum R. upstream 10/ 6/ | 20 | 6 | 6 | 16 | 75 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Oak Cr. | Mouth 10/ | 2 | 0.7 | 1 | 4 | 10 | -- | -- | 150 | 100 | -- | -- | -- | -- | -- | -- | -- |
| Greasy Cr. | Mouth 10/ | 12 | 5 | 4 | 11 | 30 | -- | -- | 650 | 400 | -- | 30 | -- | -- | 200 | 300 | -- |
| Rock Cr. | Mouth 10/ | 5 | 1 | 0.8 | 2 | 25 | -- | -- | 200 | 200 | -- | 25 | -- | -- | 150 | 150 | -- |
| Woods Cr. | Mouth 10/ | 4 | 0.9 | 0.5 | 1 | 15 | -- | -- | 300 | 200 | -- | -- | -- | -- | -- | -- | -- |
| Blakesley | Mouth 10/ | 1 | 0.2 | 0.2 | 0.5 | 8 | -- | -- | 100 | 70 | -- | -- | -- | -- | -- | -- | -- |
| Tumtum R. | Mouth 10/ 6/ | 18 | 5 | 5 | 12 | 30 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Mulkey Cr. | Mouth 10/ | 3 | 2 | 2 | 4 | 9 | -- | -- | 100 | 90 | -- | -- | -- | -- | -- | -- | -- |
| Shotpouch | Mouth 10/ | 7 | 3 | 2 | 5 | 25 | -- | -- | 400 | 250 | -- | -- | -- | -- | -- | -- | -- |
| W.F. Marys R. | River mile 3 10/ | 2 | 2 | 0.8 | 2 | 14 | -- | -- | 40 | 20 | -- | -- | -- | -- | -- | -- | -- |
| Oleman Cr. | Mouth 10/ | 1 | 1 | 1 | 3 | 18 | -- | -- | 40 | 30 | -- | -- | -- | -- | -- | -- | -- |
| Subbasin 7 Molalla R. | Mouth to Milk Cr. 14/ | 177 | 94 | 134 | 484 | 300 | -- | 1400 | -- | -- | -- | 500 | 1200 | 3100 | -- | -- | 400 |
| | Milk Cr. to Dickey Cr. 8/ | 126 | 49 | 116 | 462 | 300 | -- | 2400 | -- | -- | -- | 500 | 2800 | 5400 | -- | -- | 850 |
| | Dickey Cr. to N.F. Molalla 8/ | 126 | 49 | 116 | 462 | 300 | -- | 700 | -- | 100 | -- | 500 | 850 | 1500 | -- | 70 | 100 |
| | N. Fork to Pine Cr. 8/ | 101 | 59 | 77 | 303 | 140 | 150 | 1000 | -- | 150 | -- | 140 | 1000 | 10 | -- | 90 | 150 |
| | Pine Cr. to Table Rock Fk. 8/ | 88 | 51 | 71 | 269 | 140 | 250 | 350 | 450 | 350 | -- | 140 | 1800 | 100 | -- | 150 | 300 |

Addendum A (continued)

| Stream | Stream Section or Measuring Point | Existing Summer Flows 2/ Monthly Mean (c.f.s.) | | | | Minimum Flow Required for Balance of Year 3/ | Present Potential Escapement | | | | | Optimum Flow (c.f.s.) & Resulting Additional Escapement 4/ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | July | August | Sept. | Oct. | | S. Chin. | F. Chin. | Coho | W. Sthd. | S. Sthd. | Year Around Optimum Flow | S. Chin. | F. Chin. | Coho | W. Sthd. | S. Sthd. |
| Molalla R. (cont.) | Table Rock Fk. upstream 8/ | 38 | 28 | 54 | 154 | 80 | 150 | 200 | 250 | 150 | -- | 80 | 900 | 50 | -- | 70 | 150 |
| Milk Cr. | Mouth to Nate Cr. 10/ | 51 | 25 | 18 | 22 | 85 | -- | 150 | 550 | 350 | -- | 85 | -- | 80 | 350 | 250 | -- |
| | Nate Cr. upstream 10/ | 26 | 12 | 8 | 54 | 40 | -- | -- | 600 | 350 | -- | 40 | -- | -- | 850 | 550 | -- |
| Woodcock | Mouth to Sorenson Cr. 10/ | 2 | 0.5 | 0.5 | 3 | 10 | -- | -- | 200 | -- | -- | -- | -- | -- | -- | -- | -- |
| Nate Cr. | Mouth 10/ | 4 | 3 | 3 | 19 | 20 | -- | -- | 250 | 150 | -- | -- | -- | -- | -- | -- | -- |
| N.F. Nate | Mouth 10/ | 3 | 1 | 1 | 8 | 8 | -- | -- | 30 | -- | -- | -- | -- | -- | -- | -- | -- |
| Canyon | Mouth 10/ | 6 | 4 | 3 | 17 | 30 | -- | -- | 100 | 150 | -- | -- | -- | -- | -- | -- | -- |
| Bee Cr. | Mouth 10/ | 3 | 3 | 2 | 12 | 12 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Jackson | Mouth 10/ | 4 | 2 | 2 | 13 | 12 | -- | -- | 30 | -- | -- | -- | -- | -- | -- | -- | -- |
| Mill Cr. | Mouth 10/ | 3 | 0.6 | 0.6 | 10 | 9 | -- | -- | 40 | -- | -- | -- | -- | -- | -- | -- | -- |
| Dickey Cr. | Mouth 10/ | 0.7 | 0.5 | 0.5 | 3 | 5 | -- | -- | 20 | -- | -- | -- | -- | -- | -- | -- | -- |
| Cedar Cr. | Mouth 10/ | 1 | 0.5 | 0.5 | 3 | 5 | -- | -- | 40 | -- | -- | -- | -- | -- | -- | -- | -- |
| N.F. Molalla | Mouth 10/ | 47 | 21 | 28 | 187 | 80 | -- | -- | 250 | 1600 | -- | -- | -- | -- | -- | -- | -- |
| Trout Cr. | Mouth 10/ | 7 | 4 | 3 | 17 | 35 | -- | -- | 20 | 100 | -- | -- | -- | -- | -- | -- | -- |
| Pine Cr. | Mouth 10/ | 6 | 4 | 3 | 17 | 50 | -- | -- | -- | 80 | -- | -- | -- | -- | -- | -- | -- |
| Gawley Cr. | Mouth 10/ | 9 | 4 | 2 | 16 | 20 | -- | -- | 20 | 100 | -- | -- | -- | -- | -- | -- | -- |
| Table Rock Fk | Mouth 10/ | 50 | 23 | 17 | 115 | 80 | -- | -- | 100 | 600 | -- | -- | -- | -- | -- | -- | -- |
| Ogle Cr. | Mouth 10/ | 2 | 0.9 | 0.9 | 6 | 25 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Pudding R. | Mouth 8/ | 104 | 53 | 81 | 353 | 80 | -- | -- | 100 | -- | -- | -- | -- | -- | -- | -- | -- |
| Butte Cr. | Mouth 10/ | 12 | 4 | 6 | 59 | 75 | -- | 250 | 400 | 450 | -- | 75 | -- | 200 | 350 | 450 | -- |
| Abiqua Cr. | Mouth to L. Abiqua Cr. 10/ | 42 | 15 | 16 | 157 | 75 | 60 | 250 | 650 | 500 | -- | 75 | 600 | 150 | 1100 | 700 | -- |
| | L. Abiqua upstream 10/ | 32 | 11 | 19 | 186 | 50 | 40 | -- | 600 | 350 | -- | 50 | 350 | -- | 250 | -- | -- |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Abiqua Cr. (cont.) Powers Cr. | Mouth 10/ | 9 | 3 | 3 | 32 | 25 | -- | -- | 70 | 70 | -- | -- | -- | -- | -- | -- | -- |
| L. Abiqua | Mouth 10/ | 12 | 4 | 4 | 6 | 20 | -- | -- | 250 | 200 | -- | -- | -- | -- | -- | -- | -- |
| Silver Cr. | Mouth 8/ | 23 | 15 | 11 | 27 | 60 | -- | 300 | 700 | 950 | -- | 60 | -- | 400 | 600 | 950 | -- |
| Drift Cr. | Mouth 10/ | 0.3 | 0.1 | 0.1 | 1 | 40 | -- | -- | 250 | 200 | -- | 40 | -- | -- | 750 | 300 | -- |
| E.F. Drift | Mouth 10/ | 0.1 | 0 | 0 | 0.4 | 20 | -- | -- | 100 | 30 | -- | -- | -- | -- | -- | -- | -- |
| W.F. Drift | Mouth 10/ | 0 | 0 | 0 | 0.1 | 10 | -- | -- | 20 | -- | -- | -- | -- | -- | -- | -- | -- |
| Mill Cr. | USGS gage 14-1920 8/ | 72 | 76 | 78 | 96 | 75 | -- | -- | 400 | 600 | 450 | -- | -- | -- | -- | -- | -- |
| Subbasin 8 Tualatin R. | Mouth to Oswego Canal 6/ 8/ (USGS gage 14-2075) | 100 | 45 | 72 | 208 | 30 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | Oswego Canal to Dairy Cr. 9/ | 60 | 23 | 43 | 238 | 30 | -- | -- | 40 | -- | -- | -- | -- | -- | -- | -- | -- |
| | Dairy Cr. to Gales Cr. 6/ 14/ | 69 | 27 | 36 | 192 | 30 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | Gales Cr. to Scoggins Cr. (USGS gage 14-2035) 6/ 8/ | 22 | 12 | 15 | 74 | 30 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | Scoggins Cr. to Gaston 6/ 14/ | 10 | 6 | 9 | 49 | 30 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | Gaston to Lee Falls (River mile 70) 14/ | 10 | 6 | 9 | 49 | 65 | -- | 200 | 500 | 250 | -- | 65 | -- | -- | 250 | 300 | -- |
| McFee Cr. | Above Gulf Canyon Cr. | No measurements | | | | 12 | -- | -- | 100 | 50 | -- | -- | -- | -- | -- | -- | -- |
| Dairy Cr. | Mouth 10/ | 48 | 23 | 32 | 180 | 15 | -- | -- | 300 | 150 | -- | -- | -- | -- | -- | -- | -- |
| E.F. Dairy | Mouth to Plentywater Cr. 10/ | 35 | 14 | 19 | 110 | 50 | -- | 200 | 650 | 500 | -- | 50 | -- | 90 | 200 | 250 | -- |
| Denny Cr. | Mouth 10/ | 8 | 3 | 4 | 25 | 15 | -- | -- | 70 | 50 | -- | -- | -- | -- | -- | -- | -- |
| Plentywater | Mouth 10/ | 3 | 2 | 3 | 16 | 5 | -- | -- | 10 | -- | -- | -- | -- | -- | -- | -- | -- |
| McKay Cr. | Below E. F. McKay Cr. 10/ | 8 | 3 | | 24 | 36 | -- | -- | 300 | 200 | -- | -- | -- | -- | -- | -- | -- |
| E.F. McKay | Mouth 10/ | 2 | 0.4 | 0.6 | 3 | 18 | -- | -- | 40 | 100 | -- | -- | -- | -- | -- | -- | -- |
| Gales Cr. | Mouth to L. Beaver Cr. 10/ | 47 | 15 | 21 | 118 | 100 | -- | 60 | 950 | 650 | -- | 100 | -- | 70 | 550 | 250 | -- |
| | L. Beaver Cr. upstream 10/ | 11 | 5 | 6 | 20 | 70 | -- | 300 | 1400 | 800 | -- | 70 | - | 30 | 700 | 300 | -- |
| L. Beaver Cr. | Mouth 10/ | 2 | 1 | 1 | 5 | 10 | -- | -- | 10 | -- | -- | -- | -- | -- | -- | -- | -- |

Addendum A (continued)

| Stream | Stream Section or Measuring Point | Existing Summer Flows 2/ Monthly Mean (c.f.s.) | | | | Minimum Flow Required for Balance of Year 3/ | Present Potential Escapement | | | | | Optimum Flow (c.f.s.) & Resulting Additional Escapement 4/ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | July | August | Sept. | Oct. | | S. Chin. | F. Chin. | Coho | W. Sthd. | S. Sthd. | Year Around Optimum Flow | S. Chin. | F. Chin. | Coho | W. Sthd. | S. Sthd. |
| Gales Cr. (cont.) Iller Cr. | Mouth 10/ | 5 | 0.8 | 1 | 6 | 23 | -- | -- | 150 | 100 | -- | -- | -- | -- | -- | -- | -- |
| Beaver Cr. | Mouth 10/ | 4 | 0.9 | 1 | 7 | 17 | -- | -- | 150 | 100 | -- | -- | -- | -- | -- | -- | -- |
| N.F. Gales | Mouth 10/ | 3 | 2 | 2 | 12 | 25 | -- | -- | 30 | 20 | -- | -- | -- | -- | -- | -- | -- |
| S.F. Gales | Mouth 10/ | 3 | 0.9 | 1 | 7 | 20 | -- | -- | 30 | 40 | -- | -- | -- | -- | -- | -- | -- |
| Scoggins Cr. | Mouth 8/ | 12 | 6 | 6 | 25 | 40 | -- | -- | 850 | 550 | -- | -- | -- | -- | -- | -- | -- |
| Seine Cr. | Mouth 10/ | 8 | 1 | 2 | 10 | 25 | -- | -- | 400 | 300 | -- | -- | -- | -- | -- | -- | -- |
| Tanner Cr. | Mouth 10/ | 3 | 0.9 | 1 | 7 | 9 | -- | -- | 70 | -- | -- | -- | -- | -- | -- | -- | -- |
| Subbasin 9 Clackamas R. | Mouth to Clear Cr. 9/ | 1415 | 1007 | 923 | 1633 | 800 | 350 | 250 | 40 | 150 | 150 | 850 | 1800 | 650 | -- | 150 | 150 |
| | Clear Cr. to Deep Cr. 14/ | 1335 | 981 | 903 | 1497 | 800 | 150 | 150 | -- | 80 | 80 | 850 | 900 | 350 | -- | 80 | 80 |
| | Deep Cr. to Eagle Cr. 14/ | 1232 | 946 | 894 | 1438 | 800 | 200 | 200 | -- | 100 | 100 | 850 | 1100 | 400 | -- | 80 | 80 |
| | Eagle Cr. to River Mill Dam (USGS gage 14-2100) 14/ | 1086 | 867 | 1021 | 1735 | 800 | 250 | 250 | -- | 100 | 100 | 850 | 1300 | 450 | -- | 90 | 90 |
| | River Mill to Collowash River (USGS gage 14-2095) 5/ | 861 | 726 | 850 | 1250 | 500 | 350 | -- | 150 | 350 | 250 | 700 | 3100 | -- | -- | 150 | 150 |
| | Collowash R. to Big Bottom (USGS gage 14-2090) 8/ | 302 | 266 | 256 | 294 | 240 | 100 | -- | -- | 60 | 60 | 240 | 700 | -- | -- | 40 | 40 |
| | Big Bottom upstream 8/ | 302 | 266 | 256 | 294 | 240 | 150 | -- | 300 | 400 | 250 | -- | -- | -- | -- | -- | -- |
| Clear Cr. | Mouth to Viola 10/ | 80 | 26 | 20 | 136 | 110 | -- | 350 | 250 | 450 | -- | 110 | -- | 300 | 1000 | 800 | -- |
| | Viola upstream 10/ | 60 | 25 | 18 | 122 | 70 | -- | 150 | 250 | 450 | -- | 70 | -- | 200 | 850 | 800 | -- |
| Deep Cr. | Mouth to Tickle Cr. 10/ | 23 | 9 | 9 | 59 | 35 | -- | 60 | 250 | 150 | | 35 | -- | 40 | 350 | 200 | -- |
| | Tickle Cr. upstream 10/ | 8 | 4 | 3 | 19 | 35 | -- | -- | 450 | 200 | -- | -- | -- | -- | -- | -- | -- |
| N.F. Deep | Mouth 10/ | 4 | 0.4 | 0.3 | 2 | 20 | -- | -- | 150 | 100 | -- | 20 | -- | -- | 300 | 250 | -- |
| Tickle Cr. | Mouth 10/ | 11 | 5 | 6 | 38 | 30 | -- | -- | 400 | 250 | -- | -- | -- | -- | -- | -- | -- |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Eagle Cr. | Mouth to N.F. Eagle 10/ | 261 | 48 | 33 | 224 | 125 | 90 | 200 | 300 | 150 | 150 | 125 | -- | 150 | 400 | 150 | 150 |
| | N. Fork to hatchery 10/ | 185 | 28 | 24 | 164 | 125 | 60 | 200 | 450 | 300 | 150 | 125 | -- | 150 | 400 | 150 | 150 |
| N.F. Eagle | Mouth 10/ | 76 | 20 | 9 | 60 | 45 | -- | -- | 450 | 450 | -- | -- | -- | -- | -- | -- | -- |
| S.F. Clacka-mas | Mouth 10/ | 66 | 30 | 21 | 143 | 75 | -- | -- | .20 | 30 | -- | -- | -- | -- | -- | -- | -- |
| Fish Cr. | Mouth to Wash Cr. 10/ | 103 | 14 | 15 | 104 | 60 | -- | -- | 300 | 300 | -- | -- | -- | -- | -- | -- | -- |
| | Wash Cr. upstream 10/ | 18 | 4 | 4 | 27 | 30 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Wash Cr. | Mouth 10/ | 35 | 4 | 4 | 25 | 25 | -- | -- | 20 | 60 | -- | -- | -- | -- | -- | -- | -- |
| Roaring R. | Mouth 9/ | 115 | 55 | 50 | 58 | 100 | -- | -- | -- | 100 | -- | -- | -- | -- | -- | -- | -- |
| Oak Grove Fk | Mouth 5/ | No measurements | | | | 60 | -- | -- | -- | 150 | -- | -- | -- | -- | -- | -- | -- |
| Collowash R. | Mouth 9/ | 196 | 144 | 60 | 69 | 250 | -- | -- | 50 | 150 | 150 | 250 | 100 | -- | -- | 10 | 10 |
| Hot Springs Fork | Mouth 10/ | 112 | 35 | 18 | 124 | 75 | -- | -- | 250 | 400 | -- | -- | -- | -- | -- | -- | -- |
| Elk Lake Fk | Mouth 10/ | 50 | 27 | 16 | 108 | 40 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| E.F. Collo-wash R. | Mouth 10/ | 32 | 21 | 8 | 54 | 30 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Pinhead Cr. | Mouth 10/ | 110 | 95 | 102 | 130 | 75 | -- | -- | 100 | 150 | -- | -- | -- | -- | -- | -- | -- |
| Lowe Cr. | Mouth 10/ | 7 | 3 | 2 | 15 | 8 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Small streams tributary to Willamette R. Abernathy Cr. | | No measurements | | | | -- | -- | -- | 150 | 100 | -- | -- | -- | -- | -- | -- | -- |
| Subbasin 10 Small streams tributary to Scappoose Bay Milton Cr. | Mouth to Salmon Cr. 10/ | 10 | 6 | 5 | 22 | 25 | -- | -- | 80 | 80 | -- | -- | -- | -- | -- | -- | -- |
| Cox Cr. | Mouth 10/ | 2 | 0.8 | 0.6 | 3 | 6 | -- | -- | 60 | 40 | -- | -- | -- | -- | -- | -- | -- |
| Salmon Cr. | Mouth 10/ | 0.7 | 0.5 | 0.4 | 2 | 5 | -- | -- | 10 | 10 | -- | -- | -- | -- | -- | -- | -- |
| Scappoose | Mouth to N & S Forks 10/ | 35 | 13 | 12 | 53 | 65 | -- | 70 | -- | -- | -- | 65 | -- | 60 | -- | -- | -- |
| N. F. Scappoose | Mouth to Bonnie Falls 10/ | 22 | 6 | 6 | 26 | 40 | -- | -- | 150 | 150 | -- | 40 | -- | -- | 400 | 200 | -- |

Addendum A (continued)

| Stream | Stream Section or Measuring Point | Existing Summer Flows 2/ Monthly Mean (c.f.s.) | | | | Minimum Flow Required for Balance of Year 3/ | Present Potential Escapement | | | | | Optimum Flow (c.f.s.) & Resulting Additional Escapement 4/ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | July | August | Sept. | Oct. | | S. Chin. | F. Chin. | Coho | W. Sthd. | S. Sthd. | Year Around Optimum Flow | S. Chin. | F. Chin. | Coho | W. Sthd. | S. Sthd. |
| N.F. Scappoose (cont.) | Bonnie Falls upstream 10/ | 21 | 5 | 6 | 24 | 40 | -- | -- | 150 | 200 | -- | 40 | -- | -- | 300 | 100 | -- |
| Sierkes | Mouth 10/ | 0.8 | 0.5 | 0.4 | 2 | 7 | -- | -- | 10 | 10 | -- | -- | -- | -- | -- | -- | -- |
| Alder Cr. | Mouth 10/ | 2 | 0.8 | 0.9 | 4 | 8 | -- | -- | 40 | 40 | -- | -- | -- | -- | -- | -- | -- |
| Cedar Cr. | Mouth 10/ | 2 | 0.4 | 0.6 | 3 | 6 | -- | -- | 30 | 20 | -- | -- | -- | -- | -- | -- | -- |
| Chapman | Mouth 10/ | 2 | 1 | 1 | 4 | 6 | -- | -- | 30 | 20 | -- | -- | -- | -- | -- | -- | -- |
| N.F. of N. Scappoose | Mouth 10/ | 3 | 0.8 | 0.9 | 4 | 7 | -- | -- | 30 | 40 | -- | -- | -- | -- | -- | -- | -- |
| S.F. of N. Scappoose | Mouth 10/ | 3 | 1 | 1 | 5 | 8 | -- | -- | 80 | 70 | -- | -- | -- | -- | -- | -- | -- |
| S. F. Scappoose | Mouth to Raymond Cr. 10/ | 13 | 7 | 5 | 23 | 25 | -- | -- | 150 | 200 | -- | -- | -- | -- | -- | -- | -- |
| Gourlay | Mouth 10/ | 1 | 0.8 | 1 | 6 | 10 | -- | -- | 10 | 10 | -- | -- | -- | -- | -- | -- | -- |
| Raymond | Mouth 10/ | 2 | 0.9 | 1 | 5 | 8 | -- | -- | 30 | 30 | -- | -- | -- | -- | -- | -- | -- |
| Small streams tributary to Willamette R. Johnson Cr. | USGS gage 2115 8/ | 2 | 1 | 1 | 9 | 25 | -- | -- | 100 | 70 | -- | -- | -- | -- | -- | -- | -- |
| Crystal Cr. | Mouth 10/ | 16 | 19 | 17 | 20 | 15 | -- | -- | 30 | 30 | -- | -- | -- | -- | -- | -- | -- |
| Kellogg Cr. | | No measurements | | | | -- | -- | -- | 60 | 20 | -- | -- | -- | -- | -- | -- | -- |
| Subbasin 11 Sandy River | Mouth to Bull Run R. (Mouth) 5/ | 737 | 551 | 799 | 2091 | 510 | 350 | 650 | -- | 900 | -- | 525 | 350 | 500 | -- | 300 | -- |
| | Bull Run R. to Marmot Dam (below dam) 15/ | 35 | 35 | 35 | 242 | 225 | 200 | 400 | 100 | 500 | -- | 225 | 200 | 300 | -- | 150 | -- |
| | Marmot Dam to Salmon R. (USGS gage 14-1370) 8/ | 617 | 444 | 460 | 842 | 300 | 80 | -- | -- | 250 | -- | 300 | 80 | -- | -- | 70 | -- |
| | Salmon R. upstream 14/ | 402 | 264 | 360 | 332 | 250 | -- | -- | -- | 250 | -- | -- | -- | -- | -- | -- | -- |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sandy River (cont.) | | | | | | | | | | | | | | | | | |
| Beaver Cr. | Mouth 10/ | 3 | 1 | 1 | 5 | 14 | -- | -- | 100 | 90 | -- | -- | -- | -- | -- | -- | -- |
| Gordan Cr. | Mouth 10/ | 32 | 20 | 20 | 100 | 50 | -- | 80 | 100 | 550 | -- | -- | -- | -- | -- | -- | -- |
| Bull Run R. | Mouth to Bull Run Dam #2 (USGS gage 14-1400) 5/ | 232 | 216 | 319 | 848 | -- | -- | -- | -- | 450 | -- | -- | -- | -- | -- | -- | -- |
| Cedar Cr. | Mouth 9/ | 22 | 16 | 12 | 17 | 60 | -- | -- | 200 | 400 | -- | -- | -- | -- | -- | -- | -- |
| Alder Cr. | Mouth 10/ | 18 | 6 | 6 | 31 | 25 | -- | -- | 60 | 50 | -- | -- | -- | -- | -- | -- | -- |
| Salmon R. | Mouth to S.F. Salmon 10/ | 215 | 180 | 100 | 510 | 250 | -- | 200 | 650 | 400 | 350 | -- | -- | -- | -- | -- | -- |
| Boulder | Mouth 10/ | 19 | 6 | 4 | 18 | 30 | -- | -- | -- | 40 | -- | -- | -- | -- | -- | -- | -- |
| Cheeney | Mouth 10/ | 15 | 7 | 4 | 19 | 35 | -- | -- | 20 | 40 | -- | -- | -- | -- | -- | -- | -- |
| S.F. Salmon | Mouth 10/ | 14 | 8 | 6 | 29 | 35 | -- | -- | -- | 10 | -- | -- | -- | -- | -- | -- | -- |
| Zigzag R. | Mouth 10/ | 250 | 130 | 110 | 300 | 200 | -- | -- | -- | 350 | -- | -- | -- | -- | -- | -- | -- |
| Still Cr. | Mouth 10/ | 62 | 33 | 24 | 80 | 60 | -- | -- | 250 | 700 | -- | -- | -- | -- | -- | -- | -- |
| Henry Cr. | Mouth 10/ | 8 | 4 | 2 | 12 | 18 | -- | -- | 20 | 20 | -- | -- | -- | -- | -- | -- | -- |
| Camp Cr. | Mouth 10/ | 46 | 25 | 13 | 67 | 25 | -- | -- | 90 | 150 | -- | -- | -- | -- | -- | -- | -- |
| Clear Cr. | Mouth 10/ | 30 | 9 | 6 | 29 | 45 | -- | -- | 100 | 90 | -- | -- | -- | -- | -- | -- | -- |
| Clear Fk. | Mouth 10/ | 30 | 12 | 8 | 41 | 25 | -- | -- | 40 | 70 | -- | -- | -- | -- | -- | -- | -- |
| Lost Cr. | Near Cast Cr. 10/ | 38 | 18 | 13 | 68 | 20 | -- | -- | 90 | 200 | -- | -- | -- | -- | -- | -- | -- |
| Small streams tributary to Columbia R. | | | | | | | | | | | | | | | | | |
| Latourell | Mouth 10/ | 8 | 4 | 4 | 18 | -- | -- | -- | 30 | 40 | -- | -- | -- | -- | -- | -- | -- |
| Bridal Veil | Mouth 10/ | 18 | 9 | 5 | 27 | -- | -- | -- | 10 | 10 | -- | -- | -- | -- | -- | -- | -- |
| Wahkeena | Mouth 10/ | 6 | 4 | 4 | 20 | -- | -- | -- | 10 | 10 | -- | -- | -- | -- | -- | -- | -- |
| Multnomah | Mouth 10/ | 10 | 5 | 4 | 22 | -- | -- | -- | 20 | 20 | -- | -- | -- | -- | -- | -- | -- |
| Oneonta Cr. | Mouth 10/ | 9 | 4 | 3 | 14 | -- | -- | -- | 10 | 10 | -- | -- | -- | -- | -- | -- | -- |
| Horsetail | Mouth 10/ | 7 | 4 | 4 | 20 | -- | -- | -- | 10 | 10 | -- | -- | -- | -- | -- | -- | -- |
| McCord Cr. | Mouth 10/ | 5 | 2 | 1 | 6 | -- | -- | -- | 10 | 10 | -- | -- | -- | -- | -- | -- | -- |
| Moffett Cr. | Mouth 10/ | 2 | 1 | 1 | 6 | -- | -- | -- | 10 | 10 | -- | -- | -- | -- | -- | -- | -- |
| Tanner Cr. | Hatchery dam 10/ | 42 | 20 | 30 | 153 | -- | -- | -- | 20 | 50 | -- | -- | -- | -- | -- | -- | -- |

**Addendum A (continued)**

1/ Fish estimates for tributaries where existing flows have not been designated have been assigned to the larger stream to which the tributary is joined.

2/ N designates natural flows, S for flows from storage; no notation indicates all natural flow.

3/ These minimum flows also apply in the summer months when existing flows are higher.

4/ To obtain the indicated escapement from listed flows, the following conditions must be maintained for salmon, steelhead, and other trout:
1. From egg deposition to fry emergence, water temperature should stay within the range of 45 to 55° F., and maximum stream flow should not exceed 4 times the optimum flow.
2. For rearing of juvenile salmonids, water temperature through the summer should normally be between 50 to 60° F.
3. In addition, all other water quality conditions necessary for fish production, such as dissolved oxygen, pH, turbidity, etc., must be met.
4. Project water releases should hold downstream surface level fluctuation rates to less than six inches per hour to prevent stranding of fish in the affected areas.

5/ Source of flows: USGS gage records 1956-1960.

6/ Flows indicated for this reach are required for upstream and downstream migration of anadromous fish. Year-round flows of 140 c.f.s. at Willamette Falls fishway must be augmented by the following flows for attraction water:

| | |
|---|---|
| January 1 thru April 15 | 910 c.f.s. |
| April 16 thru June 15 | 730 c.f.s. |
| June 16 thru October 31 | 260 c.f.s. |
| Nov. 1 thru Dec. 31 | 1,330 c.f.s. |

7/ Source of flows: Observations by Fish Commission of Oregon.

8/ Source of flows: USGS gage records 1956-1965.

9/ Source of flows: All available USGS gage records 1956-1965.

10/ Source of flows: Oregon State Game Commission's miscellaneous stream flow measurements.

11/ Source of flows: USGS gage records minus average monthly canal flows calculated by Eugene Water and Electric Board.

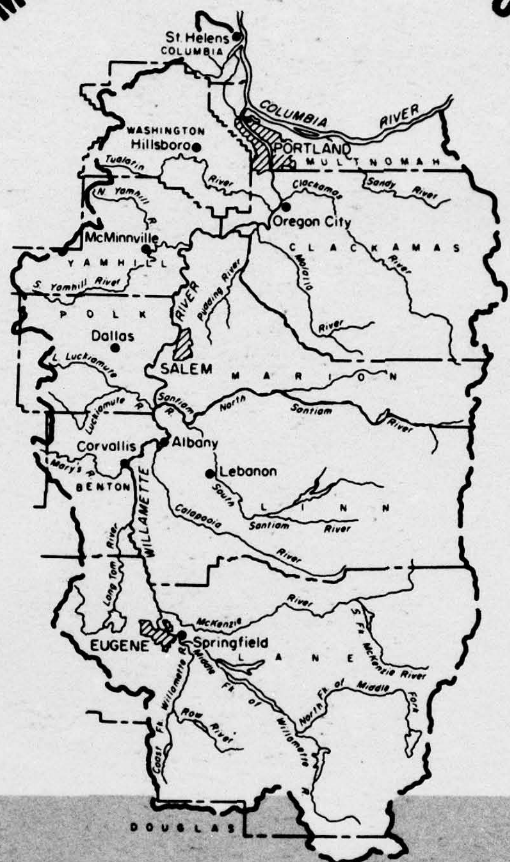
12/ Letter to Mr. Swidler, Federal Power Commission, from Assistant Secretary of the Interior, Kenneth Holum, concerning FPC License No. 2510, dated August 6, 1965.

13/ Letter to Mr. Swidler, FPC, from Assistant Secretary of the Interior, Kenneth Holum, concerning FPC License No. 2496, dated August 6, 1965.

14/ Source of flows: USGS gage records combined with OSGC measurements.

15/ Source of flows: USGS gage records minus Marmot Canal flow of 600 c.f.s. except a minimum flow of 35 c.f.s.

# COMPREHENSIVE STUDY




# Willamette Basin

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